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A Subway and Rapid Transit System . . .

for San Francisco

Report to Mayor Elmer E. Robinson
by Paul Oppermann, Director of Planning
APRIL 1950
San Francisco Department of City Planning

Including report to City Planning Commission
By DeLeuw, Cather and Company . . .

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FOR SAN FRANCISCO

A Report to Mayor Elmer E. Robinson
By Paul Oppermann, Director of Planning

Including a Report to the City Planning Commission
by De Leuw, Cather & Company

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San Francisco Department of City Planning

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A Report to the City Planning Commission by
De Leuw, Cather & Company

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Summary of Recommendations

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1. It is recommended that a first-stage program of construction be undertaken on a subway and rapid transit system in the amount of $50,100,000.

2. It is recommended that a two-track subway be constructed under Market Street between the Bay Bridge Terminal and Gough Street at a cost of $23,500,000.

3. It is recommended that two routes be initially established:

    1) a Twin Peaks route, extending from the Market Street subway through the Twin Peaks Tunnel and under West Portal Avenue to a terminal at St. Francis Circle. This route, including 60 specially designed rapid transit cars will cost $8,500,000.

    2) a Sunset route, extending from the Market Street subway through the Sunset Tunnel, under Frederick Street to Arguello Boulevard, and along the southern border of Golden Gate Park to a terminal at Nineteenth Avenue. This route, including 30 specially designed rapid transit cars, will cost $8,500,00.

4. Costs for fixed equipment, including track and power facilities for the system are estimated to be $5,800,000.

5. A division terminal with storage and maintenance facilities is recommended for construction between Market, Mission, Fremont, and Beale Streets. This will cost $6,800,000, but approximately $3,000,000 can be recouped through the resale of air rights.

6. It is recommended that additional equipment needed for completion of the rehabilitation of the present surface transit system be authorized at this time. Costs will be estimated by the Public Utilities Commission.

I. The Transit Problem and the Shelf of Solutions

Anyone who knows San Francisco knows that its most obvious transportation problem is Market Street. Like an arrow it cuts diagonally across the City from The Embarcadero to Twin Peaks. It pierces the heart of Downtown San Francisco. All but seven percent of the streets leading into the Downtown district converge on it. Practically everything and everybody gets jammed up at or on Market Street. Street cars average only 5½ miles per hour along its surface during the evening peak hour of travel. Buses and automobiles wait up to five minutes to get across it.

When Jaspar O'Farrell in 1849 enlarged the rectangular street system earlier established along the shores of Yerba Buena Cove he showed great wisdom for his time in establishing the 120-foot width of Market Street. But he also established the primary cause of San Francisco's unique circulation problem today when he laid out a separate system of streets south of Market Street, disconnected and unrelated to those north of Market Street. There are 28 streets converging on Market Street from the north and west between First and Tenth Streets, but only eight streets to carry their traffic across Market to the south. No greater barrier to smooth circulation than those two street systems was ever constructed.

Of the 29 existing radial transit lines which link the outlying districts of the City with Downtown, all but four either enter Market Street at the inner portion of their route, cross Market Street, or stop at the Market Street barrier, requiring a transfer for completion of a transit journey to the eastern end of Market Street. Of the lines stopping at Market Street half of the eight routes formerly entered Market Street, but total volumes of vehicles and passengers have increased so that these lines can no longer be absorbed into the traffic stream.

Traffic attempting to cross Market Street is congested and delayed by traffic on Market Street, and the saturation of traffic on Market Street is congested and delayed by traffic attempting to cross it. Thus Market Street, the great wide boulevard of downtown San Francisco, is also its great obstacle to a smooth flowing circulation system.

Market Street Subway Is of Long Standing

The key importance of Market Street has long been as obvious as it is today, and every consideration given to the improvement of circulation, and particularly toward the improvement of transit over the past fifty years, has included major recommendations for increasing the capacity and efficiency of Market Street through "vertical widening" by means of a subway.

Daniel Burnham, noted city planner of his time, in 1905 in his Report on a Plan for San Francisco foresaw the need for a system of rapid transit subways as the City grew and developed. "The most pressing need at present is that of Market Street," he wrote.

Bion Arnold, transportation engineer who designed the Twin Peaks Tunnel, in 1913 in his Report on the Improvement and Development of the Transportation Facilities of San Francisco, stated that "Provision for a Market Street subway should be incorporated in any Twin Peaks tunnel project--i.e., the alignment and grade of the tunnel under the hill should be such as to emerge directly into a suitable subway bore under Market Street, whether the latter is built now or in the future."

The subtitle of City Engineer M. M. O'Shaughnessy's report in 1931 on Rapid Transit Plans for the City of San Francisco--With Special Consideration to a Subway Under Market Street indicates the growing importance of the Market Street problem by that time. His was the first study and report to make specific proposals for immediate subway construction to solve the Market Street problem by separating the main flow of transit traffic along that thoroughfare from other types of conflicting traffic.

A comprehensive plan of rapid transit routes was proposed of which the main elements were: 1) a Market Street subway from the Bay Bridge Terminal, through the Twin Peaks Tunnel, and down Nineteenth Avenue to the county line near Junipero Serra and Alemany Boulevards, with initial construction proposed under Market Street from First Street to Gough Street; 2) a Mission route running under Mission and Capp Streets, and along the old Southern Pacific right-of-way through the Bernal Cut to a junction with the Twin Peaks Tunnel route near the county line; 3) a route under O'Farrell and Geary Streets to Park-Presidio Boulevard; and 4) a route through the Sunset Tunnel to a terminal near 20th Avenue and Irving Street. Street cars were proposed for operation in this system.

In 1936, in a report to the Public Utilities Commission rendered by its staff and Robert Ridgway and Alfred Brahdy, Consulting Engineers, on Rapid Transit for San Francisco, a subway system for initial use by street cars was recommended consisting of: 1) a Market Street subway from the Bay Bridge Terminal to Church Street with 2) a branch off Market Street under South Van Ness Avenue and Mission Street, and through the Bernal Cut to Balboa Park; and 3) a line under Montgomery and Geary Streets to Hamilton Square. A future connection from the Bay Bridge Terminal under Rincon Hill to the Peninsula trunk line at Third and Townsend Streets was also suggested.

This plan was put before the voters in a general obligation bond issue of $49,250,000, in November of 1937. The bond issue was defeated by a vote of 95,246 in opposition to 68,834 in favor. The defeat was ascribed to the fact that the City's transit was then split between the system of the Market Street Railway Company, which carried two-thirds of the total transit riders, and the system of the Municipal Railway, which carried one-third of the total volume of transit passengers. The subway plan was designed to serve only the Municipal Railway, system, benefiting directly only one-third of the transit riders. One of the arguments against the plan at the time was that the City should first acquire the Market Street Railway System and combine it with the municipal system before embarking on a rapid transit program. Acquisition of the Market Street Railway was accomplished seven years later, in 1944, thus clearing the way for development of a unified system of transit serving all districts of the City equally.

In 1947 the Joint Army-Navy Board in its report on An Additional Crossing of San Francisco Bay recommended development of a transbay rapid transit system as the only long-range solution to the transbay transportation problem, and it also made general recommendations for a network of subways in San Francisco including a main line under Market Street.

More recent studies and reports are discussed in detail in the report of the engineering consultants, De Leuw, Cather & Company, dated April, 1950 which is transmitted as Part II of this report.

It is worthy of attention that essentially all previous recommendations agree on the need for a rapid transit subway under Market Street as the major step toward alleviating the conditions of congestion in Downtown San Francisco. Furthermore, there is remarkable similarity between the functional aspects of the systems as recommended for the outlying areas of the City.

Of all the previous recommendations, only one has been carried to the test of submission to the electorate. Thirteen years have passed, and there have been many changes in conditions: population has increased 27 percent in San Francisco and as much as 200 percent in some adjoining counties; technological advances have improved greatly the speed, comfort, and convenience of rapid transit vehicles and the esthetic aspects of subway structures; the entire surface transit system of San Francisco is now authorized for operation under one management with resultant opportunities for integrating the system into a rapid transit system that will benefit all transit riders.

II. Criteria of a Good Transit Plan

Review and analysis of the existing transit system and development of a general plan for changes in the system to include provisions for rapid transit, have been made with certain basic objectives, principles and standards as a guide. These criteria are described in this Chapter.

Objectives of the Subway and Transit Plan

The subway and transit plan recommended has been developed to facilitate the attainment to the greatest degree possible of the objectives set forth below.

1. To provide a comprehensive system of transit routes covering every inhabited section or point of interest in SanFrancisco, located and designed to afford maximum convenience and serviceability and to link all parts together as directly and conveniently as possible.

Data on origins and destinations as derived from the comprehensive Bay Area Metropolitan Traffic Survey of 1947 and from an analysis of the density and distribution of present and future resident population and working population have been used to develop routes which would serve best the greatest number of present and potential riders.

2. To provide San Francisco with complete facilities for the expeditious, convenient, comfortable,and safe movement of persons by public transit vehicles between each neighborhood of the City and 1) the Downtown business and shopping district, 2) other working or employment areas of the City, 3) park and recreation areas of Citywide importance, and 4) all other neighborhoods of the City.

Fulfillment of this objective would make the transit system as attractive for trips which begin and end outside the Downtown district of the City as for trips to and from that focal area.

3. To ensure that the transit system is fully coordinated with the trafficways plan for freeways and major thoroughfares, with all present and foreseeable future Bay Area transit facilities serving the City, and with other major elements of the Master Plan.

4. To provide for the use of various types of transit vehicles, each where most suitable and effective, so that the service as a whole will compare favorably with or be superior to travel by private automobile in relation to such factors as convenience, comfort, speed, safety, and cost to the rider, particularly in travel to and from the Downtown district.

This objective offers the only effective solution to the problem of congestion in the Downtown district.

5. To preserve present desirable land uses and to further and develop desirable future land uses as shown in the Master Plan.

Principles Applied to the Plan

The following principles have been derived from a study of how to attain these objectives, and have been applied in developing the proposed system of rapid transit.

1. The transit system should consist of three principal functional types of routes organized to provide the shortest possible travel time between points of origin and destinations:

   (a) trunk line radial routes originating in the Downtown district of the City and extending to the outlying working areas and to business centers and residential neighborhoods in the community areas.

   (b) circumferential crosstown routes, crossing and serving as feeders to the radial routes, and connecting outlying residential and business districts directly with each other and with working areas.

   (c) shuttle feeder routes connecting outlying neighborhood and hilltop areas with radial routes.

Plates 5 and 6 show these three types of routes on the existing surface transit system, and on the proposed modifications to the system as coordinated with the rapid transit lines.

2. Radial and crosstown trolley and gas bus routes should make maximum use of established trafficways, passing between or skirting residential communities and neighborhoods. In the Downtown district some surface streets should be designated for primary use by transit vehicles, freeing other streets for automobile and other types of vehicular traffic. In outlying residential neighborhoods such transit routes may utilize local neighborhood streets to a limited extent where topographic conditions or the size and layout of the neighborhood requires such use for adequate coverage.

3. Where passenger volumes and length of trips warrant, radial routes should be developed as rapid transit routes providing fast through express service on separate rights-of-way: freeway or expressway roadways for buses, and subways, center divider strips on freeways, or other special rights-of-way at grade for rail transit vehicles.

The recommended rapid transit routes comply fully with this principle.

4. Wherever possible transit lines should be routed on the same trafficway or street in both directions, rather than on one-way streets. Specific streets should be established and identified as transit route streets.

Standards of the Plan

The following standards have been applied in the development of the recommended transit plan:

1. Overall travel time should be as short as possible. The measure of overall travel time should include 1) vehicle running time, 2) time required for walking to or from the point of origin or destination to the point of boarding or alighting from the transit vehicles, and 3) half of the headway between vehicles on the route, i.e., average waiting time.

Plate 7, shows the travel times required during peak hours on the existing transit system. A comparison with the time required to travel by automobile reveals that transit trips today require approximately twice the time required for a comparable trip by automobile. This one factor alone accounts for much of the diversion from the use of transit toward the use of automobiles in the daily journey to work. The recommended rapid transit plan will cut present transit travel time in half, as shown on Plate 8.

2. Standards of service should provide on the average a seat for each passenger during off-peak travel periods and a limit of standees on rubber-tired vehicles to 50 percent of the number of seated passengers per vehicle during peak travel periods.

San Franciscans, habituated to conditions of crowding, push into transit vehicles far beyond their comfortable capacity. An increased number of transit vehicles and improvements in surface traffic conditions so that schedules may be more easily maintained, will aid in the achievement of this standard. The construction of a subway under Market Street, however, will afford the greatest relief to present conditions of transit congestion.

3. Transit routes generally should be so located to provide service to any developed part of the City within one-quarter mile walking distance, i.e., five-minute walking time. The average spacing between transit lines should be approximately one-half mile except in areas of high population density or where special topographic conditions prevail, where closer spacings may be necessary.

The present transit system, being a composite of two formerly distinct and separate systems - those operated by the Market Street Railway and by the Municipal Railway - is characterized by duplication of routes in older areas of the City, and by a degree of under-service in newer areas of the City. The present rehabilitation program of the Municipal Railway offers opportunities for elimination of overlapping routes, and consequent better service on remaining routes. The subway and rapid transit system recommended in this report further enables this standard of transit service to be attained.

4. The transit system should provide generally for a transit trip from any part of the City to any other without inconvenient multiple transfers.

The present practice of shortening radial routes by a turn-back at Market Street during off-peak hours, requires at least one transfer to complete a radial trip into the Downtown area, and at least two transfers to make connections between radial lines from the north and south and radial lines to the west. The resulting inconvenience is a deterrent to the use of transit during off-peak hours which the proposed rapid transit system would overcome.

5. Sheltered waiting stations should be provided at all transfer points and at all other major loading points.

Plate 11 shows a perspective drawing of the transfer terminal proposed at St. Francis Circle. All stations on the subway routes would be designed to permit easy over-the-platform transferring from feeder bus routes to the rapid transit trains without requiring hazardous crossings of streets and intersections.

6. Transit vehicles should provide optimum passenger comfort through clean appearance and design, good ventilation, generous windows, wide entrance and exit doors, minimum noise, and smooth acceleration and deceleration.

The rapid transit vehicles proposed for operation on the subway routes, described in Chapter III and on page 19 of the engineering consultant's report, fully meet these standards.

III Recommended Subway and Rapid Transit Plan

It takes almost twice as long in travel time from the Downtown district to reach outlying residential districts--such as the Richmond, Sunset, West of Twin Peaks, Mission, or Bayview--by public transit than it does by automobile. To counter this great advantage of the automobile, one of the primary aims in the development of a public transit system that will compare favorably in terms of convenience, comfort, and cost, with travel by automobile is to make more nearly equal the travel times by the two types of facility.

In order that this may be accomplished in San Francisco the areas more than three miles from Montgomery and Market Streets--west of Presidio Avenue and Eureka Valley and south of Army Street--must be brought closer to the Downtown district by means of rapid and express transit service. A comparison of Plate 7, showing existing transit travel time zones from Montgomery and Market Streets during peak hours, with Plate 8, showing time zones that would result with the development of the rapid transit system here proposed, shows that the usual transit trip can be cut in half by development of the proposed system.

The subway system proposed shown on Plate 3, consists of four radial trunk-line rail subway routes to serve the western and southwestern sections of the City, and trunk-line express bus routes on the Bayshore Freeway to serve the southeast section of the City.

The routes recommended are:

1. Twin Peaks Route - Market Street.

The proposed Market Street Subway extends from the Bay Bridge Terminal at Mission and Fremont Streets via a loop running under Beale Street, Pine Street, and Sansome Street to Market Street, and thence west to the Twin Peaks Tunnel. The subway is two-track west of Sansome Street, the eastbound loop track running via First Street to the Bay Bridge Terminal. The Twin Peaks Route extends west from the Market Street subway through the Twin Peaks Tunnel and under West Portal Avenue, the existing Municipal Railway right-of-way through Lakeside, under Nineteenth Avenue and Worcester Street, and across the Stanley Drive Parkway to a terminal at the Southern Pacific right-of-way near the county line. The total distance of this route is 8-1/2 miles from the Bay Bridge Terminal to its southerly terminal. There are eight stations proposed west of Van Ness Avenue. The total running time between the Bay Bridge Terminal and the outer terminal, including stops, is estimated at 28 minutes. From Montgomery and Market Streets to St. Francis Circle, the peak-hour total running time would be 18 minutes. Feeder and crosstown bus routes serving hilltop, lakeside, and oceanside neighborhoods would connect with this rapid transit route at Church Street, Eureka Valley, Forest Hill, West Portal, St. Francis Circle, Stonestown, and Parkmerced.

2. Sunset Route - Market Street.

The Sunset Route branches off the Market Street subway at Duboce Avenue and extends west from the Sunset Terminal in subway to Arguello Boulevard and Lincoln Way, and then along the south side of Golden Gate Park--the route of the southern branch of the Panhandle Freeway--to a terminal at Nineteenth Avenue. There are four stations proposed west of Van Ness Avenue. The total running time between the Bay Bridge Terminal and Nineteenth Avenue including stops, is estimated at 19-1/2 minutes. From Montgomery and Market Streets to Nineteenth Avenue, the peak-hour total travel time would be 16-1/2 minutes. Feeder and crosstown bus routes

serving the slopes of Buena Vista and Twin Peaks, Parnassus Heights and Golden Gate Heights, and the entire Sunset district, would connect with this rapid transit route at Church Street, Cole or Stanyan Street, Ninth Avenue, and Nineteenth Avenue.

3. Mission Route - Market Street.

The Mission Route branches off the Market Street subway at Van Ness Avenue and extends south under South Van Ness Avenue and thence along the central mall of the proposed Mission Freeway to a common terminal with the Twin Peaks route near the junction of Alemany and Junipero Serra Boulevards. Permanent vehicle storage facilities are proposed at this terminal point. Extension along the Southern Pacific right-of-way and City-owned right-of-way of the abandoned San Mateo Interurban streetcar line as far as San Bruno would provide trunk line service to the rapidly developing hills and valley in northern San Mateo County, southwest of Lake Merced and the San Bruno Mountains. There are seven stations proposed south of Van Ness Avenue and north of the county line. The total running time between the Bay Bridge Terminal and the outer terminal near the county line, including stops, is estimated at 24 minutes. From Montgomery and Market Streets to Army Street the peak hour total travel time would be 12 minutes; to Balboa Park and City College 18-1/2 minutes. Feeder and crosstown bus routes would connect with this rapid transit route at Sixteenth Street, Twenty-second Street, Bernal, Glen Park, Balboa Park (Ocean Avenue), and Sagamore, and buses serving the residential districts in northern San Mateo County would connect with the line at its county line terminal, until it can be extended southward toward San Bruno.

4. Geary - Park-Presidio Route.

The Geary route is proposed as a two-track subway extending from Montgomery Street under Geary Street, and in the center mall of Park-Presidio Boulevard, developed as a freeway, to California Street. There are seven stations proposed west of Van Ness Avenue. From Montgomery and Market Streets to Geary and Park-Presidio Boulevards, the peak-hour total travel time would be 14 minutes. Feeder and crosstown bus lines serving the Richmond District and the Western Addition would connect with this rapid transit route at all stations.

Serious consideration was given in this study to the extension of the Sunset Route northward across Golden Gate Park and along Park-Presidio Boulevard in lieu of the Geary route. However, the damage to the Park that would be required, the greater travel time, and the lesser number of persons north of the Park served by this line, all led to the conclusion that the Geary Route is more desirable and economically justifiable.

Integration With a Bay Area Transit System

The need for improved transit facilities is not restricted solely to San Francisco, but extends throughout the Bay Area. Action on the problem from an Areawide approach seems likely to occur in the not very distant future. The Army-Navy Board, in its report on An Additional Crossing of San Francisco Bay gave impetus to development of a regional transit plan, legislation authorizing creation of a Bay Area Transit District was passed in 1949, a citizens' advisory committee presently is actively considering the areawide needs, at least one privately owned company serving suburban areas has indicated a desire to abandon its operations entirely, East Bay cities are considering a joint attack on their problem, and interest is generally stirring throughout the Bay Area toward development of a fully integrated system of transit serving the entire Bay Area.

The rapid transit plan proposed for San Francisco has been developed to fit into an Areawide system of transit. In the recommended plan the Bay Bridge Terminal is a focal connecting point between the system serving San Francisco and the systems serving Transbay and Peninsula communities. The Bay Bridge Terminal presently serves the San Francisco-Oakland Bay Bridge transit routes, and the Market Street subway is designed to afford an easy transfer from one system to the other. (See page 12 of the report of the engineering consultants regarding the difficulties of a direct rail connection between the Bay Bridge tracks and the Market Street subway.) Future extension of the main Peninsula route, when present equipment is modified, from Third and Townsend Streets under Rincon Hill to a subway terminal at the Bay Bridge Terminal would provide for interchange between Peninsula and San Francisco and Peninsula and Transbay facilities.

Marin County could be integrated into the local system by a terminal at Park-Presidio Boulevard tieing in with the Geary route in lieu of a downtown bus terminal. The Golden Gate Bridge was designed to accommodate monorail facilities although monorail is as yet untried and unproven as a media of rapid transit. Although there may be advantages in favor of monorail in suburban areas, overhead monorail systems would be physically and esthetically undesirable on the crowded and congested streets of downtown San Francisco. Connection with the Geary subway route, should a Marin monorail system be developed in the future, would overcome this disadvantage.

The Geary route could also be tied in to the Bay Area system by terminating at the Bay Bridge Terminal. However, so far as San Francisco users of the route are affected, a terminal in Montgomery Street would be more advantageous. A transfer station to the Market Street subway at Kearny Street would afford ready access to the Bay Bridge Terminal, and it is this less costly facility for which cost estimates have been provided by the engineering consultants.

The Downtown Subway

Downtown San Francisco is a concentrated terminal area. It is there, between Van Ness Avenue and The Embarcadero, particularly along Market Street and the adjacent streets on the north, that a large majority of all transit riders either begin or end their trips. Therefore no stations in the Downtown district could be bypassed. The proposed rapid transit system will provide express service to the downtown district, but within the downtown area stops should be made at each station.

There are seven stations on the Market Street route between the Bay Bridge Terminal and Van Ness Avenue, a distance of two miles, some proposed at intervals as close as 900 feet in order to disperse adequately the concentrated volumes of passengers with destinations in the area. Nonetheless, the subway under Market Street would afford more than a one hundred percent saving of time east of Van Ness Avenue, where the bulk of the congestion and delay now occurs. In contrast with scheduled peak hour streetcar running times of 17-1/2 minutes between the Bay Bridge Terminal and Van Ness Avenue, and actual running times as high as 30 minutes, the rapid transit cars in the subway would make the trip during peak hours in 9 minutes, including stopping time at the stations. From Montgomery Street to Van Ness Avenue the running time would be 6 minutes, including stopping time.

In addition to breaking the Market Street bottleneck for the 240,000 passengers estimated to use the subway system daily by 1970, it is estimated that the Market and Geary subways will remove from the surface of Market Street one-half of the passenger load which would be forced to use that street if no subway were provided.

Station Design

The engineering consultants have recommended the construction of side platform stations rather than mezzanine stations along Market Street (see page 16 of their report). There are advantages and disadvantages for either type of station. Mezzanine stations, with a floor between the track level and the street level, provide greater flexibility for pedestrian movement, enabling passengers to enter the stations from either side of the street and reach either track. Mezzanine stations are also advantageously adapted to irregular street patterns, as entrances can be provided from any point. In addition, adjoining buildings may be connected directly with the stations.

On the other hand, mezzanine stations require an additional depth of ten feet, adding to the length of the descent or climb from or to the sidewalk level. Cost estimates for the provision of mezzanine stations between Van Ness Avenue and the Bridge Terminal would add $3,300,000 to the total cost of the subway. Construction of mezzanines at the Fourth, Third, and Second Street stations, where the greatest movement of passengers occurs, add $1,600,000 to the total cost. After considerable deliberation and evaluation of the relative advantages and disadvantages, it is recommended that mezzanine-type stations be constructed at Fourth, Third and Second Streets.

Equipment

It is recommended that the rapid transit subway route be operated with cars specially designed for rapid transit operation. Generally similar to PCC street cars in appearance, weight, acceleration, and speed, the cars are 48 feet in length, 10 feet in width, provide seats for 50 passengers, and operate in multiple units of two, four, and six car trains. Each has three doors for loading and unloading, thus expediting the movement of passengers at heavy-volume downtown stations. Both in comfort and attractiveness, this car surpasses all existing types.

The Surface Plan

Plate 6 shows a suggested plan for surface transit routes to serve and supplement the rapid transit subway system recommended. This surface plan is not intended to be considered, nor is it submitted as, a precise plan. However, it was used as a basis for estimates of passengers boarding the subway lines at each station and is shown only to illustrate how the surface transit system can be integrated into the subway system in accord with the principles and standards set forth in Chapter III. Specific routes and details of the plan will be developed and determined by the staff of the Public Utilities Commission and Col. Marmion D. Mills, consultant to the Public Utilities Commission, as the present rehabilitation program for the transit system is carried out.

It will be noted, however, how the surface system can be clearly divided into subway feeder lines, crosstown lines, and surface radial lines serving primarily the areas less than three miles from Montgomery and Market Streets. Together with the subway line proposed and express bus operation on the Bayshore Freeway, this transit system would make possible the travel times shown on Plate 8 as well as greatly simplifying and improving crosstown transit facilities.

In order to make possible this improved surface system, additional funds for completion of the rehabilitation of the present system are required. Replacement of remaining street car lines operating on the surface by trolley or gas buses,

whichever is most appropriate, and purchase of additional equipment to improve service standards, is recommended as an essential part of the next step in the transit improvement program. Total cost for this requirement will be estimated by the staff of the Public Utilities Commission.

The People Served

Plate 9 shows the growth of population between 1920 and 1947 throughout San Francisco, and the estimates made by the Department of City Planning of additional growth up to a total of 875,000 in 1970. It can be seen clearly that heaviest residential growth will occur in the southwestern section of the city. Nearly all parts of the City will experience some population growth, but the outlying sections obviously will increase the most. Some few sections are likely to lose residential population through redevelopment for industrial and commercial purposes. All of these probable changes have been considered in developing the recommended rapid transit plan.

Plate 4 shows the estimated daily volume of passengers using the subway routes based on 1950 and 1970 population estimates.

The Cost

Total estimated cost, exclusive of rapid transit cars, for the Twin Peaks, Sunset, and Mission routes, all using the Market Street subway, is $87,000,000. The Geary subway, recommended for last priority construction, is estimated to cost $47,000,000, making a grand total of $134,000,000 for the complete rapid transit system.

In order that the construction program may be carried out within the limits of the City's financial structure, it is recommended that the system be built in stages, the first stage to include 1) the Market Street subway as far west as Gough Street, and the Twin Peaks route as far west as St. Francis Circle, and the Sunset route as far west as Nineteenth Avenue.

Costs for this recommended first-stage construction program, estimated by the consulting engineers, consist of the items and amounts listed below:

Twin Peaks Route - Market Street

1. The subway construction from the Bay Bridge Terminal to the incline to the surface of Market Street at Gough Street is estimated to cost..........$18,400,000

2. Maintenance and restoration of underground utilities is estimated to cost............. 3,500,000

3. Additional cost for the three mezzanine-type stations recommended is.............. 1,600,000

   Thus the total cost of basic subway construction on Market Street is............................$23,500,000

4. Land and buildings on the site of the proposed Division Terminal (described on page 19 of the consultants' report) are estimated to cost..$3,450,000

5. Structures and fixed equipment for the Division Terminal are estimated to cost..... 3,350,000

   The total outlay for the Division Terminal is thus.........$ 6,800,000

However, since the area above the ground level will not be required for transit use, the air rights can be resold and the acquisition costs thus can be partially or entirely recouped.

6. Lowering the track in the westerly portion of the Twin Peaks Tunnel, construction of a subway under West Portal Avenue and a terminal at St. Francis Circle is estimated to cost........................ $5,600,000

7. Maintenance and restoration of underground utilities along this section is estimated to cost.................................... 200,000

   Thus the total cost of the westerly section of the Twin Peaks route is.............................. $5,800,000

8. Fixed subway equipment including track, signal, D.C. power and distribution, supervisory control, A.C. distribution, emergency alarm, communication, ventilating, and station equipment for the entire route is estimated to cost.... 5,800,000

9. Sixty rapid transit cars required for the Twin Peaks route are estimated to cost....... 2,700,000

   The total cost of initial construction of the Twin Peaks route is thus estimated to be.................. 44,600,000

   From this figure, however, may be deducted the sale value of the Division Terminal air rights, which would be approximately.............................. -3,000,000

   The net cost of the Twin Peaks route would thus be......... $41,600,000

Sunset Route

Estimates for the first-stage construction of this route were made by the consulting engineers in their report for two alternative western terminals--one at the present westerly portal of the Sunset Tunnel at Cole Street, and one requiring an extension of the route west to Stanyan Street. However, at a meeting on April 5 attended by Marmion D. Mills, Consultant to the Public Utilities Commission, William Scott, General Manager of the Municipal Railway, A. O. Olson, Chief Engineer, Utilities Engineering Bureau, L. M. Perrin, Senior Engineer, Utilities Engineering Bureau, Charles E. De Leuw, Consulting Engineer on the rapid transit plan, and Paul Oppermann, Director of Planning, it was agreed that the Sunset route should be carried to its ultimate westerly terminal at Nineteenth Avenue in the first stage of construction as the benefits of this extension would more than offset the additional cost required. This route therefore is recommended for construction as far west as Nineteenth Avenue in the first stage.

Cost estimates for this route have been submitted by the consulting engineers for a modified plan based on continued surface operation on Duboce Avenue in the first stage, and a Stanyan Street terminal requiring less property acquisition. The estimates are based on subway construction west to Arguello Boulevard and Lincoln Way, and a limited-access right-of-way on grade along the southern border of Golden Gate Park to Nineteenth Avenue.

1. The estimated cost for the subway section and grade-separated surface section west of Stanyan Street and for additional stations is...........$4,500,000
2. Fixed equipment is estimated to cost........... 350,000
3. The original estimate of the Sunset project west to Stanyan Street (see page 23 of the engineering consultants' report) less land costs of $220,000 originally included for a more extensive transfer terminal than required under the modified plan, is............. 2,300,000
4. The cost of 30 rapid transit cars required for this route is............................ 1,350,000

The total cost for initial construction of the Sunset Route to Nineteenth Avenue is thus estimated to be....................................$8,500,000

Total Cost of Recommended First-Stage Rapid Transit Construction: $50,100,000

The total net cost of the rapid transit and subway system recommended for the first stage of construction is thus $50,100,000.

It is further recommended that sufficient funds be authorized to complete the rehabilitation of the surface transit system and make available a complete fleet of modern, efficient, postwar transit vehicles. This cost will be estimated in detail by the engineers of the Public Utilities Commission.

The financial aspects of the recommended first-stage construction program are now under study by the Controller as to their application to the bonded debt structure of the City and County.

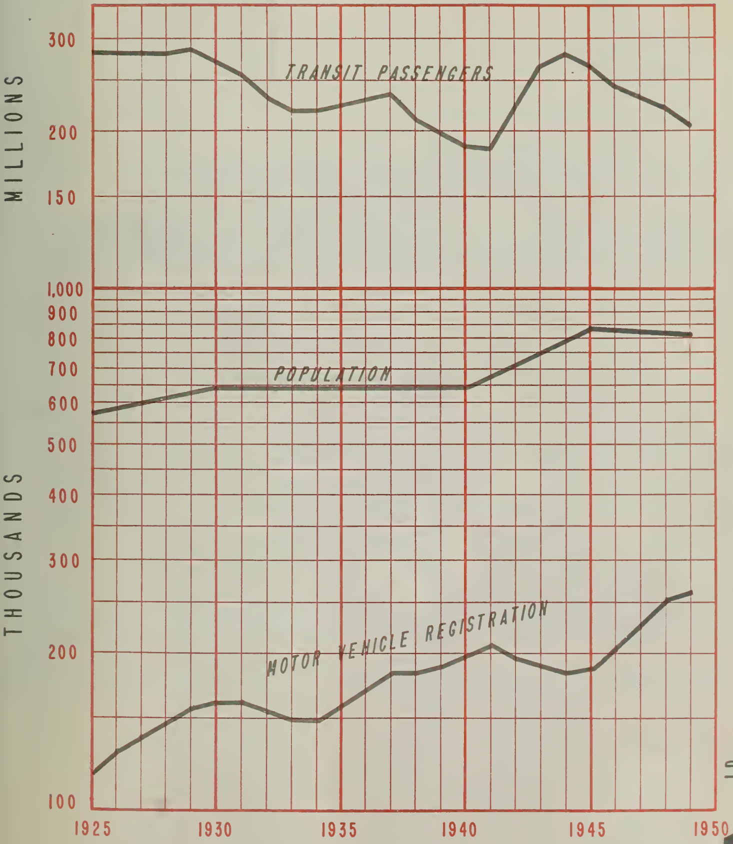
Previous Expenditures for Other Utilities and Public Facilities

San Francisco in the past has not been niggardly in its expenditures for certain other types of public utilities and facilities. Situated in a State where water is of life-or-death importance, San Francisco has not been confronted, nor will it be faced, with the problem of water shortage. San Francisco displayed foresight in the development of water acquisition, storage, and distribution facilities and has authorized nearly $173,000,000 in bonds for the development of the Hetch Hetchy system and the local water distribution system.

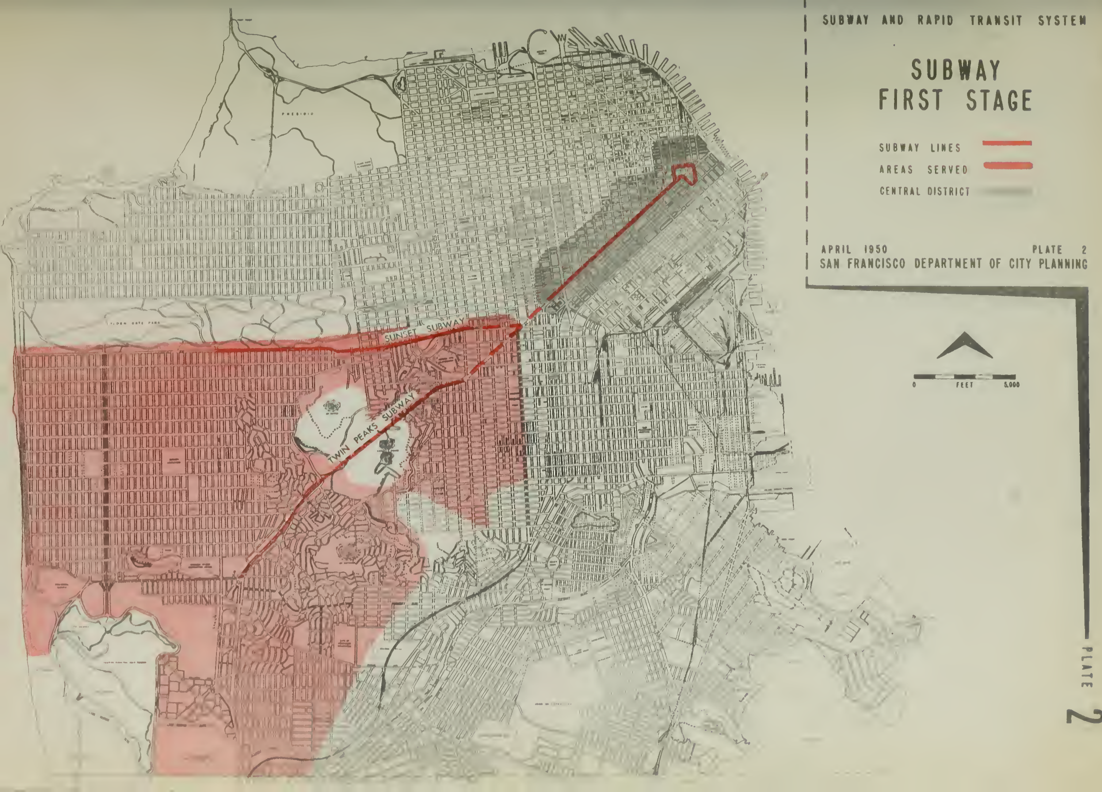
San Franciscans have authorized the issuance of $35,000,000 in bonds for sewer construction and improvements. The issuance of $75,000,000 in bonds for development of school facilities has been authorized. San Franciscans have authorized the issuance of $33,000,000 in bonds for development of its airport, a transportation facility directly benefitting relatively few San Franciscans.

Compared with these past expenditures, it does not seem disproportionate to pay $50,100,000 for a transportation improvement that will have lasting value and that will benefit directly every property owner and every resident in San Francisco.

COMPARISON OF RESIDENT POPULATION, MOTOR VEHICLE REGISTRATION, AND REVENUE TRANSIT PASSENGERS IN SAN FRANCISCO: 1925 - 1949



SAN FRANCISCO DEPARTMENT OF CITY PLANNING PLATE 1

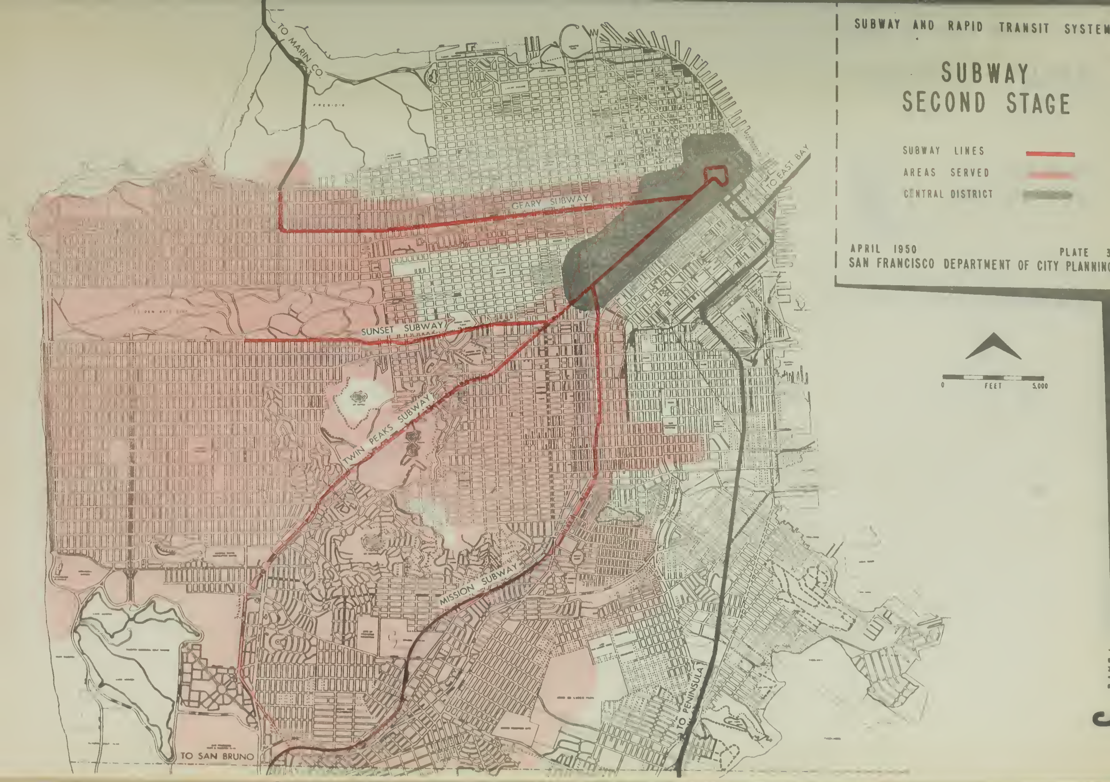

PRESIDIO
GOLDEN GATE PARK
SUNSET SUBWAY
TWIN PEAKS SUBWAY
SUBWAY LINES
AREAS SERVED
CENTRAL DISTRICT
0
FEET
5,000

SUBWAY AND RAPID TRANSIT SYSTEM

SUBWAY
FIRST STAGE

APRIL 1950 PLATE 2
SAN FRANCISCO DEPARTMENT OF CITY PLANNING

PLATE 2


TO MARIN CO.
PRESIDIO
TO EAST BAY
GEARY SUBWAY
SUNSET SUBWAY
TWIN PEAKS SUBWAY
MISSION SUBWAY
TO PENINSULA
TO SAN BRUNO
SUBWAY LINES
AREAS SERVED
CENTRAL DISTRICT
0
FEET
5,000

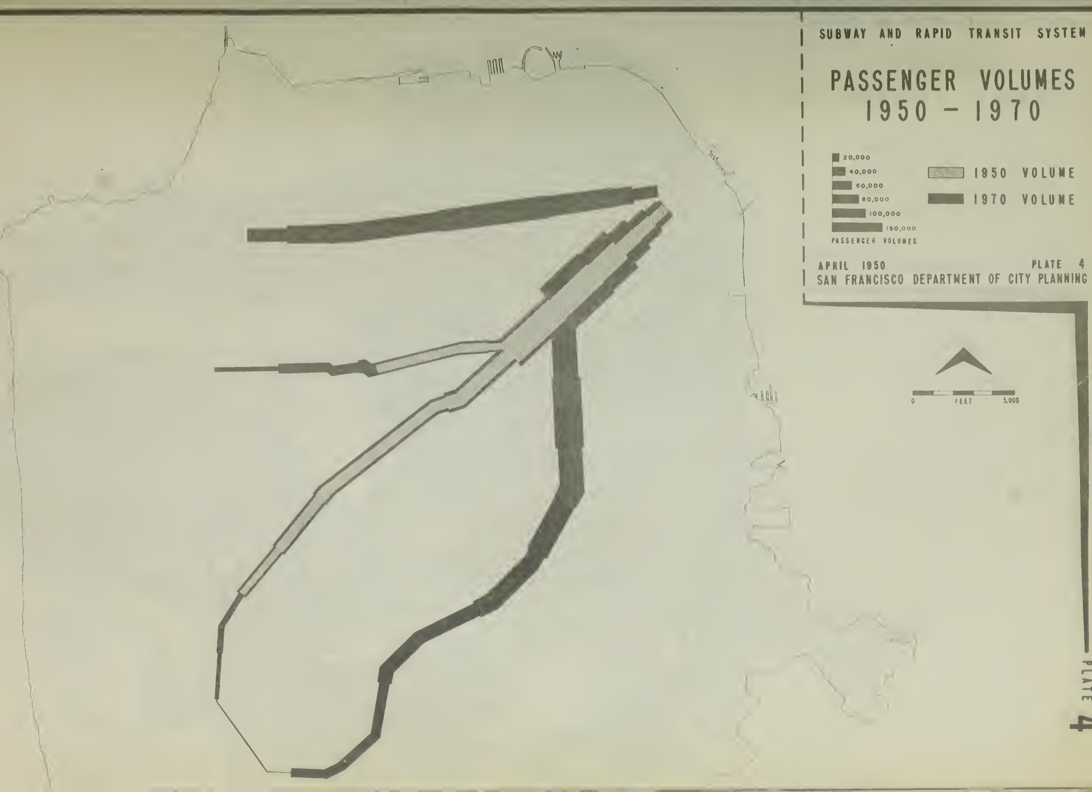
SUBWAY AND RAPID TRANSIT SYSTEM

SUBWAY
SECOND STAGE

APRIL 1950
PLATE 3
SAN FRANCISCO DEPARTMENT OF CITY PLANNING

SUBWAY AND RAPID TRANSIT SYSTEM

PASSENGER VOLUMES
1950 - 1970

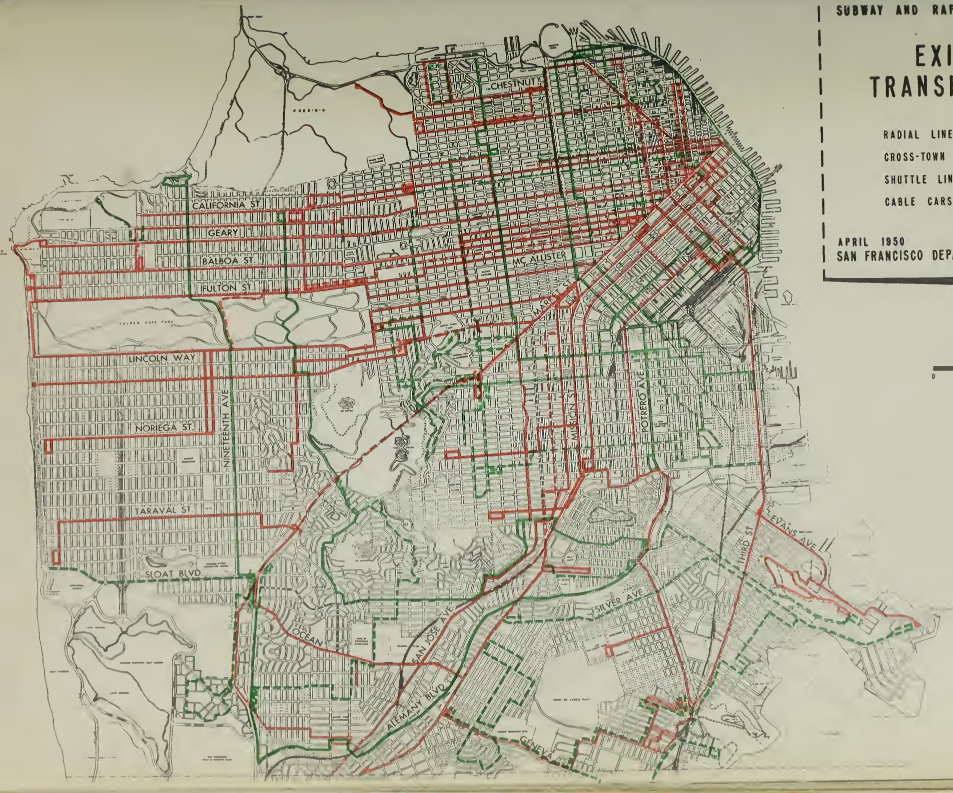

20,000
40,000
60,000
80,000
100,000
150,000
PASSENGER VOLUMES
▨ 1950 VOLUME
■ 1970 VOLUME
0
FEET
5,000

APRIL 1950 PLATE 4
SAN FRANCISCO DEPARTMENT OF CITY PLANNING

PLATE 4

SUBWAY AND RAPID TRANSIT SYSTEM

EXISTING TRANSIT SYSTEM


RADIAL LINES 🟥
CROSS-TOWN LINES 🟩
SHUTTLE LINES - - - -
CABLE CARS —·—·—
0 FEET 5,000
CHESTNUT
CALIFORNIA ST.
GEARY
BALBOA ST.
FULTON ST.
MC ALLISTER
MARKET ST.
LINCOLN WAY
NORIEGA ST.
NINETEENTH AVE
TARAVAL ST.
SLOAT BLVD.
MISSION ST.
POTRERO AVE.
THIRD ST.
EVANS AVE
SILVER AVE.
SAN JOSE AVE.
OCEAN
ALEMANY BLVD.
GENEVA
PRESIDIO
GOLDEN GATE PARK

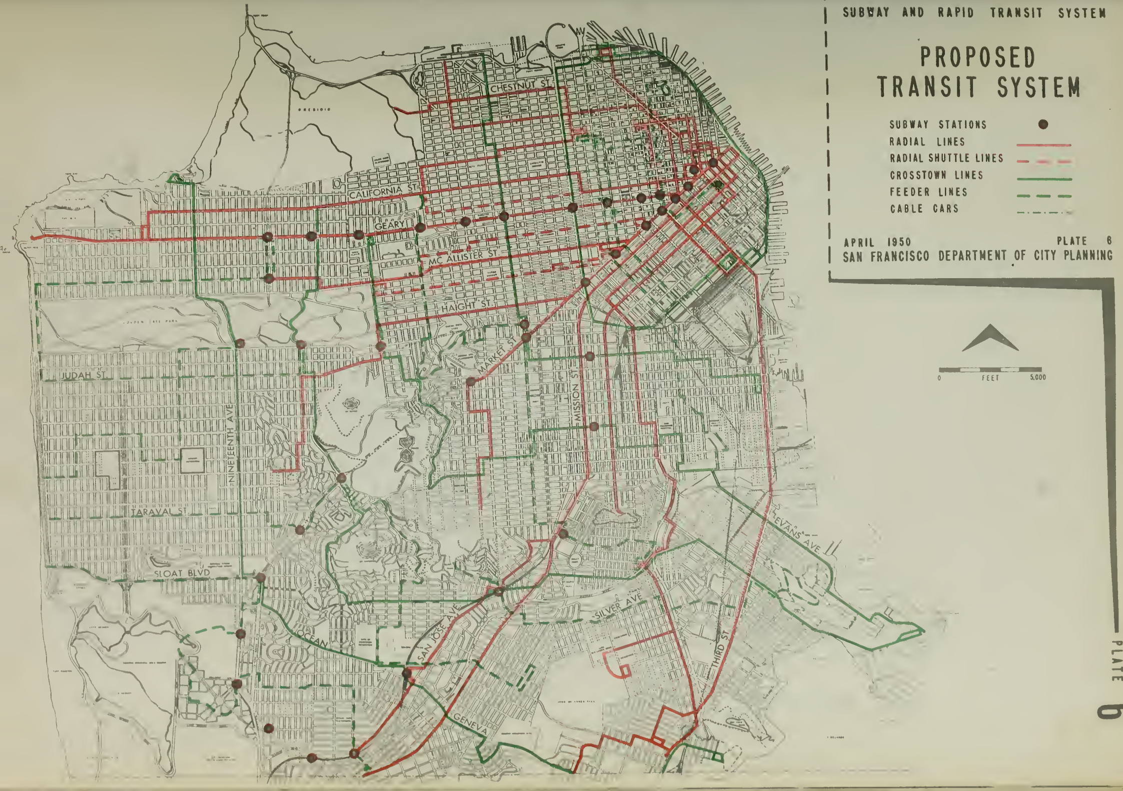
APRIL 1950
PLATE 5
SAN FRANCISCO DEPARTMENT OF CITY PLANNING

PLATE 5

PLATE 6

SUBWAY AND RAPID TRANSIT SYSTEM

PROPOSED TRANSIT SYSTEM


SUBWAY STATIONS ●
RADIAL LINES
RADIAL SHUTTLE LINES
CROSSTOWN LINES
FEEDER LINES
CABLE CARS
0
FEET
5,000
PRESIDIO
CHESTNUT ST.
CALIFORNIA ST.
GEARY
MC ALLISTER ST.
HAIGHT ST.
MARKET ST.
MISSION ST.
JUDAH ST.
NINETEENTH AVE
TARAVAL ST.
SLOAT BLVD
OCEAN
SAN JOSE AVE
GENEVA
SILVER AVE
THIRD ST.
EVANS AVE

APRIL 1950

PLATE 6

SAN FRANCISCO DEPARTMENT OF CITY PLANNING

SUBWAY AND RAPID TRANSIT SYSTEM

EXISTING TRANSIT TIME ZONES

FROM MARKET AND MONTGOMERY STS.

APRIL 1950
PLATE 7
SAN FRANCISCO DEPARTMENT OF CITY PLANNING

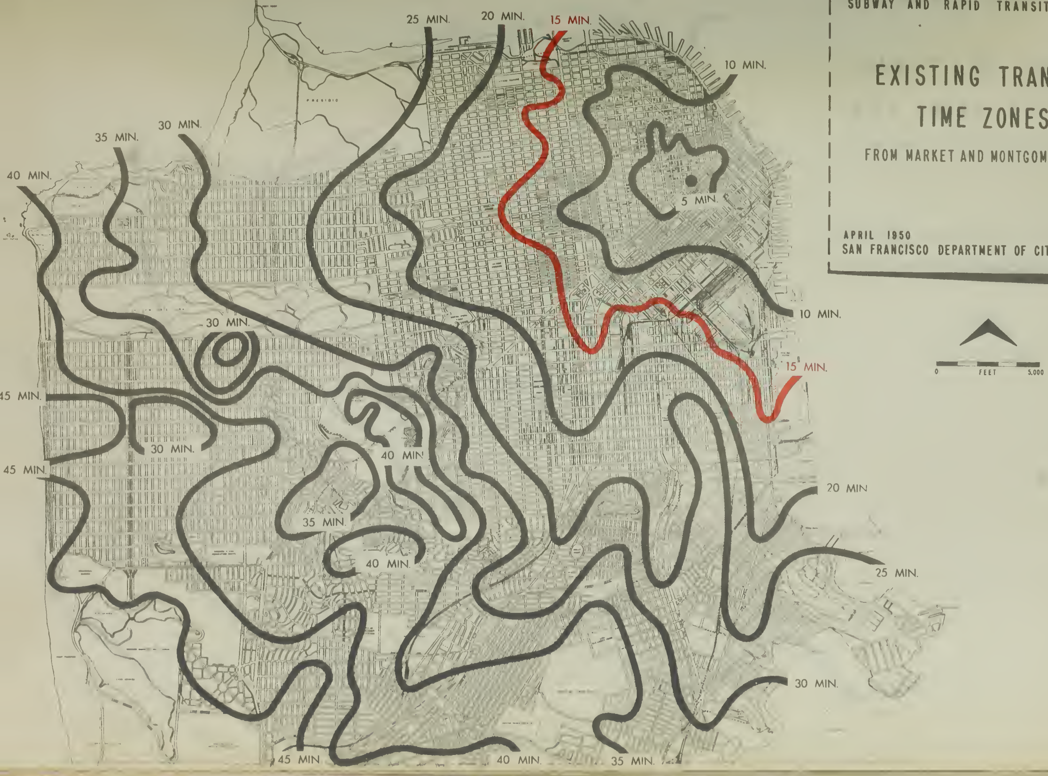

25 MIN.
20 MIN.
15 MIN.
10 MIN.
30 MIN.
35 MIN.
40 MIN.
5 MIN.
PRESIDIO
10 MIN.
30 MIN.
15 MIN.
45 MIN.
30 MIN.
40 MIN
45 MIN.
20 MIN
35 MIN.
40 MIN.
25 MIN.
30 MIN.
45 MIN
40 MIN.
35 MIN.
0
FEET
5,000

PLATE 7

TRANSIT TIME ZONES
WITH SUBWAY SYSTEM

FROM MARKET AND MONTGOMERY STS.

APRIL 1950
PLATE 8
SAN FRANCISCO DEPARTMENT OF CITY PLANNING

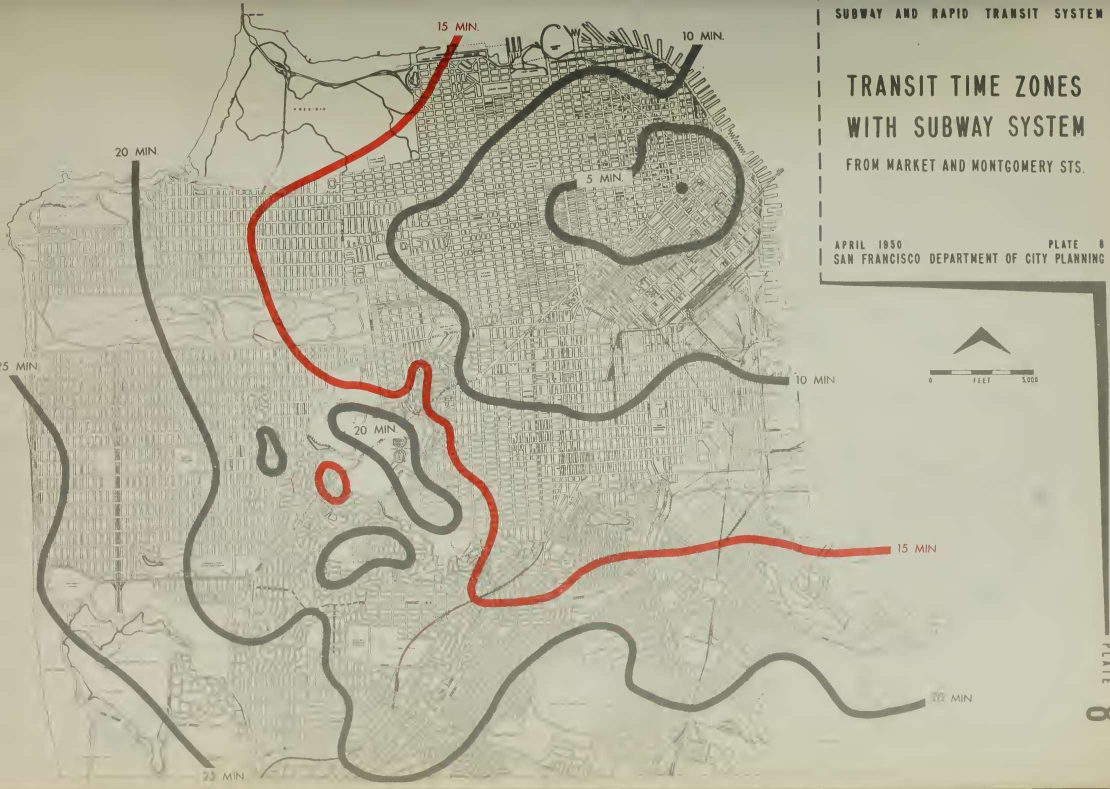
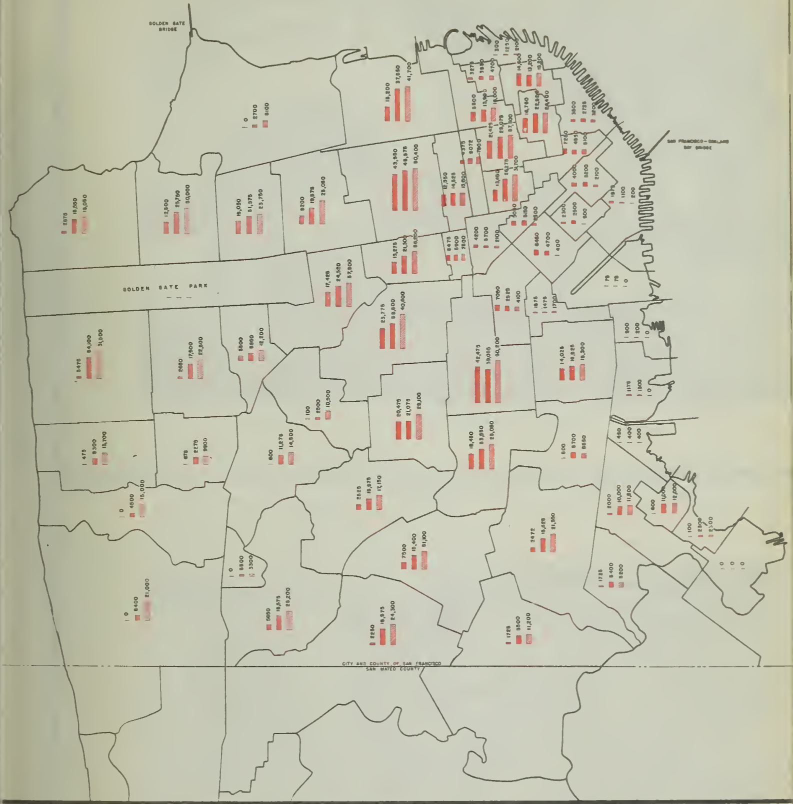

15 MIN.
10 MIN.
PRESIDIO
20 MIN.
5 MIN.
25 MIN
10 MIN
20 MIN.
15 MIN
20 MIN
25 MIN
0
FEET
5,000

PLATE 8


GOLDEN GATE BRIDGE
SAN FRANCISCO - OAKLAND BAY BRIDGE
GOLDEN GATE PARK
CITY AND COUNTY OF SAN FRANCISCO
SAN MATEO COUNTY

SUBWAY AND RAPID TRANSIT SYSTEM

POPULATION GROWTH IN SAN FRANCISCO

BY SEGMENTS 1920 - 1947 - 1970

SOURCE:
1920 - U.S. CENSUS
1947 - DEPT. OF CITY PLANNING ESTIMATES
1970 - DEPT. OF CITY PLANNING ESTIMATES

APRIL 1950

PLATE 9

SAN FRANCISCO DEPARTMENT OF CITY PLANNING

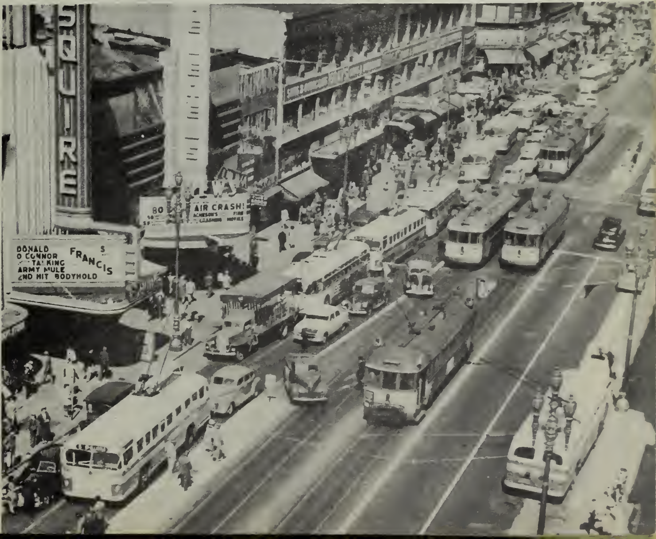
M
L
TUNNEL
P
OUT

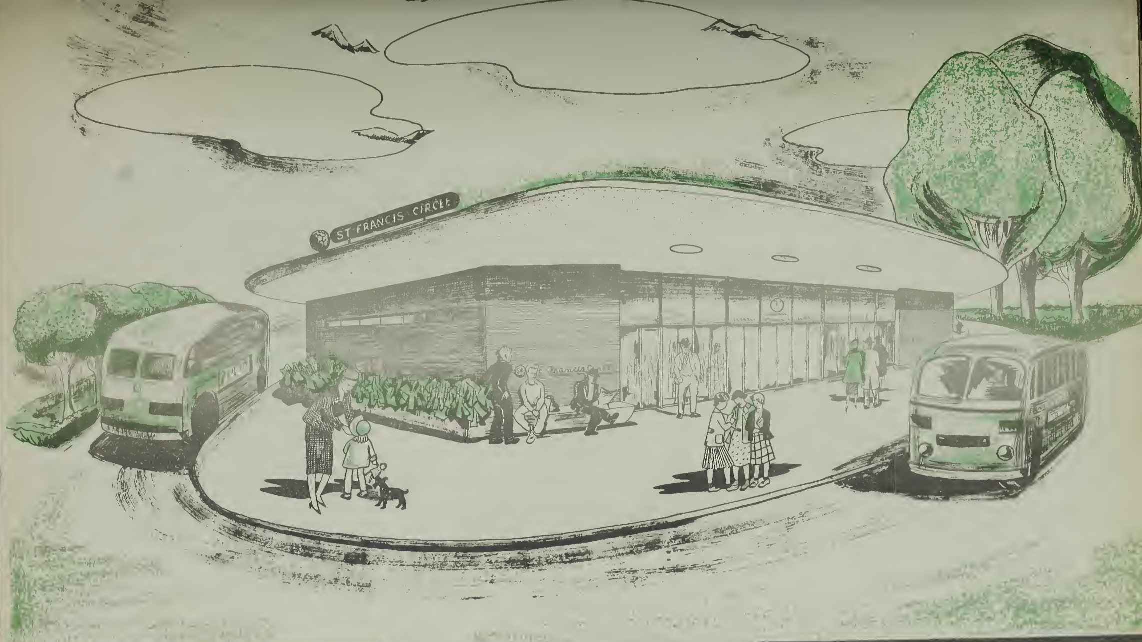
SAN FRANCISCO HAS HAD A SUBWAY LINK FOR OVER THIRTY YEARS
West Portal, Twin Peaks Tunnel

PLATE 10

STREET CARS, BUSES, TRUCKS, AUTOMOBILES, AND PEDESTRIANS ALL COMPETE FOR THE SAME SPACE ON THE SURFACE

Looking east on Market Street, between Mason, Fifth, and Powell Streets


SQUIRE
DONALD
O CONNOR
TALKING
ARMY MULE
2ND HIT BODYHOLD
FRANCIS
AIR CRASH!


ST FRANCIS CIRCLE
St Francis Circle

SUBWAY TERMINAL AT ST. FRANCIS CIRCLE

APRIL 1950

11

PLATE

SAN FRANCISCO DEPARTMENT OF CITY PLANNING

RAPID TRANSIT FOR SAN FRANCISCO

A REPORT TO THE
CITY PLANNING COMMISSION

APRIL 1950

DE LEUW, CATHER & COMPANY
ENGINEERS
79 McALLISTER STREET
SAN FRANCISCO 2, CALIF.

RAPID TRANSIT FOR SAN FRANCISCO

A REPORT TO THE

CITY PLANNING COMMISSION

APRIL 1950

DE LEUW, CATHER & COMPANY
Engineers
79 McAllister Street
San Francisco 2, California

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9 Typical Subway Station.

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13 Preliminary Plan - Division Terminal.

DE LEUW, CATHER & COMPANY
ENGINEERS
150 NORTH WACKER DRIVE
CHICAGO 6
FINANCIAL 6-0424

WESTERN OFFICE
79 McALLISTER STREET
SAN FRANCISCO 2, CALIFORNIA
UNDERHILL 1-1302

April 5, 1950

City Planning Commission
100 Larkin Street
San Francisco 2, California

Gentlemen:

On February 9, 1950 you requested us to furnish such technical services to your staff as might be required to permit you to complete a rapid transit plan for San Francisco. The assignment covered not only aid in the preparation of the long-range plan which will ultimately be required, but also a more detailed engineering study of an initial development which might be financed through an issue of general obligation bonds to be submitted to the voters at an election to be held late this year.

All previous proposals for transit development in San Francisco were to be subjected to detailed review and analysis, together with all comments, criticisms and suggestions which had been submitted by operating and technical staffs of the Public Utilities Commission and other city departments, as well as the numerous quasi-public and civic bodies which have studied this subject.

PREVIOUS PROPOSALS

While a number of reports and studies of transportation developments in San Francisco have been made during the period 1910 to 1935 it seemed desirable to limit the present study to those proposals which have been completed during the past fifteen years which are as follows

RAPID TRANSIT FOR SAN FRANCISCO
A Report by the Public Utilities
Commission, San Francisco--1936.

ARMY AND NAVY BOARD REPORT ON A
SECOND BAY CROSSING AND RELATED
MATTERS--1944.

PROPOSED SAN FRANCISCO RAPID TRANSIT
By R. S. Chew--1946. (Revised in 1948)

TRANSPORTATION PLAN FOR SAN FRANCISCO
Ladislas Segoe & Associates and DeLeuw,
Cather & Company--November 1948.

LONG-RANGE RAPID TRANSIT PROGRAM FOR
SAN FRANCISCO. By Colonel S. H. Bingham--
February 1949.

The similarity in the principal features of these various proposals prepared by agencies and individuals with varying approaches is remarkable. All plans included a rapid transit subway on Market Street extending through the Twin Peaks Tunnel to serve the southwest section of the city. There were variations only in the exact patterns of the subway proposed downtown and beyond the west portal of the tunnel.

All plans included a provision for rapid transit extending south along the general line of Mission Street and then southwest to and along the existing right-of-way owned by the Southern Pacific Company. Here again there were variations in respect to the downtown routing and termini, as well as the exact type of construction to be followed in providing for rapid transit rail operation.

Similarly, there has been common agreement on a rapid transit operation extending generally along the line of Geary Street from the downtown area to serve the Richmond district. Two of the plans provided for rapid transit service by bus, the remainder called for rapid transit subway construction, and again there were variations in the termini and routing recommended in the Richmond area and in the downtown district.

Other rapid transit or special services were recommended in various reports. There was no unanimity of thought in respect to the ultimate operation through the Sunset Tunnel; the rapid transit

service to be furnished by the operation of express buses on projected expressways; the connections to the Bay Bridge terminal tracks; the type of car equipment and other special problems. Discussion of the several routes proposed in various reports follows.

Market Street Subway

In all of the rapid transit proposals submitted during the past fifteen years, emphasis has been given to the great need for rapid transit along Market Street from a downtown terminal to a terminal at or beyond the west portal of the Twin Peaks Tunnel. The only variations in the proposals relate to the type of equipment to be operated and to the exact character of termini.

In the 1936 report street car operation was recommended, with subway construction extending from Church Street to Fremont Street, with a stub terminal on Fremont Street under the Bay Bridge terminal.

The Army-Navy Board report recommended train operation from a terminal to the southwest of the west portal to connections with a large downtown loop at Main Street.

The Chew plan provided for subway operation from the west portal to a connection with the Bay Bridge tracks by means of an elevated railroad and a subway extending along Grant and Columbus Avenues, under Telegraph Hill, and back on Sansome Street.

The 1948 plan provided for train operation from a terminal in the Lake Merced area to a downtown loop with physical transfer facilities at the Bay Bridge terminal.

The 1949 plan similarly provided service between the same terminal on the southwest but with a terminal on Montgomery Street to the north of Market Street and provision for a future extension out Columbus Avenue.

It is evident that all the engineers who have studied the problem recognize the desirability of providing convenient delivery to points in the downtown area and also distribution for those passengers from the East Bay area who start the San Francisco portion of their journey at the Bay Bridge terminal. There is also agreement on the practicability of constructing a subway along Market Street in such a way as to provide a continuous trunkline route from downtown San Francisco to or beyond the west portal of the Twin Peaks Tunnel. It may be

concluded, therefore, that any long range plan for rapid transit in San Francisco must include provision for a Market Street subway extending from a connection to the Bay Bridge terminal to the rapidly developing Lake Merced area. This project will be recommended for initial development, as will be described in detail subsequently.

Mission Route

The need for rapid transit service to the southwest has been recognized in all of the reports. Most of them provide for a connection into Market Street in the vicinity of Van Ness Avenue and the use of the Market Street subway for the downtown terminal of the route. All of them provide for the use of the right-of-way owned by the Southern Pacific Company to the Bernal Cut either to intermediate points or to termini at or beyond the south city limits.

The 1936 plan provided for a subway on Mission Street utilizing the Market Street subway for a downtown terminal. The Army-Navy Board report provided for a subway on Mission Street but with a downtown terminal in a separate subway along Harrison Street. In the Chew plan the subway was extended along Dolores Street to Market Street.

In the 1948 plan, the subway was located along Van Ness Avenue extended for a short distance, connecting to and extending along the center mall of the freeway proposed for the Mission route to a terminal near the south city limits. The 1949 plan follows almost an identical route except for the proposal to build a subway on Mission Street as compared with the utilization of the proposed Mission freeway. It develops therefore that there has been full agreement on the construction of a rapid transit rail line along the Mission route and almost full agreement on the utilization of Market Street for the downtown terminal.

Geary Route

While the authors of the several plans studied have agreed on the need for rapid transit extending straight west from the downtown district to serve the Richmond area, there has been considerable divergence of opinion as to the exact method of accomplishing same. The 1936 plan provided for a subway on Geary Street with street car operation through a two-track subway to be built on Geary Street from Steiner to Montgomery Street, and on Montgomery Street to Columbus

Avenue. The Army-Navy Board provided for a subway extending straight west from a connection with a downtown subway network on the general line of Geary Street to a point near Park Presidio Boulevard. The Chew plan suggested express bus service along the general line of Geary Street and California Street to Lincoln Park on the west. The 1948 plan provided express bus service along Geary Street to a point near Van Ness Avenue and thence through a terminal subway along Post Street. The 1949 plan provided for a subway in Geary Street and O'Farrell Street to a downtown terminal at Market Street.

There are opportunities for immediate improvement of the service to the Richmond district through the operation of express buses, and plans for redevelopment of the intermediate area include provision for development of Geary Street as a wide boulevard which would further improve the express bus service to the Richmond district. Ultimately a rapid transit subway to serve this important section of San Francisco will be required to avoid undue concentration of public transit vehicles on the intensively used streets in the downtown area. Consideration should be given to its construction at the time the Geary Street widening is carried out so as to provide for such economies as may be realized through the coordinated planning of the trafficway and transit projects. The possibilities for immediate improvement of the service through express bus operation coupled with the greater need for rapid transit service to the more remote sections of the city on the south and southwest would indicate the advisability of postponing Geary Street subway construction until some future date. Provision should be made, however, in the Market Street construction for an efficient transfer terminal in the vicinity of Kearny and Market Streets and to provide room for the short length of two-track subway on the northerly side of Market Street between Kearny and Montgomery Streets so as to provide for ultimate construction of a terminal for the Geary Street subway on Montgomery Street.

Sunset Tunnel

The 1936 plan provided for the continued operation of street cars through the Sunset Tunnel. The Army-Navy Board report included a subway extending from a terminal in the vicinity of Ninth Avenue and Judah Street to and through the Sunset Tunnel and along Duboce Avenue, 13th Street, Brannan Street, The Embarcadero and Main Street, to a connection with the Market Street subway. The Chew plan similarly provided for rapid transit service through the Sunset

Tunnel and along Duboce Avenue, to and through the Market Street subway; also an extension through Golden Gate Park to the vicinity of Fulton Street and Arguello Boulevard.

In the 1948 report, continuation of local service was recommended through the Sunset Tunnel, utilizing however, trolley buses instead of trolley cars. The 1949 report included no specific suggestion for the use of the Sunset Tunnel.

Other Routes

With the exception of the Army-Navy Board report no other proposal has been made for more extensive subway construction in San Francisco. That report, however, included, in addition to the routes mentioned above, extensive subway construction to provide for circulation in and around the central business district, with particular reference to a new terminal to be located at Army and 3rd Streets to provide convenient rapid transit facilities in connection with the construction of the Second Bay Crossing at the Army Street location. While the routes recommended by the Board would provide admirable facilities for the rapid movement of passengers in this entire area extending from Army and 3rd Streets on the southeast to Van Ness Avenue and Bay Street on the northwest, analyses of traffic which would be served by such subways indicate that there would be no economic justification for their construction.

Additional express bus operation was recommended in the 1948 transportation plan and report utilizing the facilities of the freeways included in the comprehensive freeway plan also developed in that report. Express bus operation serving the southeasterly section of the city was proposed along the Bayshore freeway now under construction. Similar services were contemplated along a section of the Central freeway and the Panhandle freeway with, as mentioned above, operation through the central business district in a subway in Post Street and 2nd Street.

There is no question as to the desirability of the utilization of the projected freeways for such rapid transit service. The route to the south city limits should be developed with the completion of the Bayshore freeway. When and as the Panhandle freeway is constructed, San Francisco should plan to realize the maximum possible benefit from the use of this thorofare, which can only be secured through the operation of public transportation buses thereon.

THE COMPREHENSIVE PLAN

After a thorough study of all pertinent reports, reconsideration of the various related problems as covered in the November 1948 TRANSPORTATION PLAN FOR SAN FRANCISCO and, finally, after detailed discussions with technical and operating personnel of the various city departments at interest, particularly those of the Municipal Railway, there has been developed a long-range rapid transit plan for San Francisco by the City Planning Commission staff in which we concur. It includes the following major projects:

1. Market Street Subway

   A two-track rapid transit subway extending from a downtown loop connecting with the Bay Bridge terminal at Fremont Street, along Market Street, through the existing Twin Peaks Tunnel, along West Portal Avenue, 19th Avenue and Worcester Street extending to a terminal at the Southern Pacific right-of-way south of Alemany Boulevard near Junipero Serra Boulevard.

2. Mission Route

   A two-track rapid transit line extending from the Market Street subway along South Van Ness Avenue and along the proposed Mission freeway to and beyond the south city limits.

3. Sunset Route

   A two-track rapid transit subway in the Market Street subway and extending along Market Street; Duboce Avenue; through the Sunset Tunnel; and through a subway extension to Arguello Boulevard, and thence along the south edge of Golden Gate Park in open cut (or as a part of the Panhandle freeway development) to a terminal at 19th Avenue; or

   A limited stop trolley bus service extending from suitable termini near the west edge of the Sunset district along existing major thorofares and through the Sunset Tunnel, and thence along Duboce Avenue and Market Street to a suitable downtown terminal.

4. Geary Street Subway

   A two-track rapid transit line in Geary Street, extending from a terminal in Montgomery Street north of Market Street, along Market Street and along Geary Street, to a terminal at Park Presidio Boulevard, with provision for future extensions to the Golden Gate Bridge, and

5. South Suburban Route

   Rapid transit operation on the Bayshore route of the Southern Pacific railroad from points in the Peninsula suburban area to the existing terminal at 3rd and Townsend Streets, with provision for ultimate extension to a terminal point at the Bay Bridge terminal.

Preliminary estimates of cost have been made covering the entire ultimate system as described above exclusive of rapid transit cars and based on present-day costs of labor and materials as follows:

1.	Market Street Subway	$ 62,000,000
2.	Mission Route	11,000,000
3.	Sunset Route (2-track rail line alternate)	14,000,000*
4.	Geary Street Subway	47,000,000
5.	South Suburban Route - not included	-
	Total	$134,000,000

*-No allowance for right-of-way in Golden Gate Park included. Subject to reduction for trolley bus alternate.

INITIAL RAPID TRANSIT DEVELOPMENT

The rapid transit routes required ultimately to provide San Francisco with adequate public transportation throughout the urban area involve such a heavy capital outlay that the financing and construction of all of the routes must obviously extend over a considerable period into the future. A detailed study has been made, therefore, of an initial program which can be undertaken in the near future at a capital outlay which may be within San Francisco's ability to pay for new and improved transit facilities.

Such a program has been developed with a view to providing the largest possible measure of improvement and convenience to transit passengers; to provide for efficient operation of rapid transit at the completion of the initial program - integrated to the maximum practicable extent with the modernized surface system, and at the same time conform to and become an integral part of the overall plan. This program has been developed by the staff of the Planning Commission, in which we concur, and consists of the following major elements:

1. A two-track subway from a terminal loop on 1st, Mission, Beale, Pine and Sansome Streets extending along Market Street to an incline connecting with the existing street railway tracks between Van Ness Avenue and Gough Street;

   Rehabilitation of fixed subway equipment throughout the Twin Peaks Tunnel and lowering the grade of the existing tracks in the tunnel west of the Forest Hill Station;

   The construction of a two-track subway from the west portal to a terminal at St. Francis Circle; and

   The construction of an underground division terminal to provide for storage, servicing, and running repairs of rapid transit cars, located in the basement area of the block bounded by Fremont, Mission, Beale and Market Streets.

2. The adjustment of the existing tracks near the west portal of the Sunset Tunnel and the extension of said tunnel so as to provide a convenient bus-rail transfer station at either Cole Street or Stanyan Street; or

   Paving and equipping the Sunset Tunnel and approaches to provide for trolley bus express service to the Sunset district.

3. The purchase of rapid transit cars for the operation of the above described rapid transit routes, together with the purchase of 200 additional trolley buses, and 300 additional modern gas buses required to complete the modernization of the surface routes of the Municipal Railway.

MARKET STREET SUBWAY

The decision on the character and exact pattern of the Market Street subway was determined after a detailed study of the various recommendations in respect to downtown termini, type of operation number of tracks, character of subway stations and related matters.

Number of Tracks

In the 1949 report the construction of a four-track subway from Van Ness Avenue to Montgomery Street was recommended, two of which would be utilized for the Market Street and two for the Mission route operation. The only reasons for constructing four tracks in any subway are:

1. To provide for the operation of express service through by-passing of individual stations by express trains, and

2. To provide capacity for large volumes of rapid transit traffic which cannot be accommodated on a two-track rail line.

Referring now to the first point: There are no stations on Market Street between Van Ness Avenue and the easterly terminal which could be by-passed. In other words, the convenience of the public will require that each train stop at each station in the central business district.

With respect to capacity, it is estimated that the traffic which may be attracted to the Market Street-Twin Peaks route and to the Mission route in the year 1970 or at such date as the outlying areas served by these routes attain their full development, would be on the order of 9,000 passengers during the maximum hour on each route. Estimates of the probable traffic on the Sunset Tunnel route show somewhat lower figures. To accommodate 9,000 passengers per hour would require - with an average loading of 100 passengers per car - the operation of 90 cars per hour. If trains were operated on a 4-minute headway, or a total of 15 trains per hour, the operation could be performed with 6-car trains on the Market and Mission routes, and shorter trains on the Sunset route. The combined headway of 80 seconds during the maximum hour would be entirely practicable, particularly in view of the excellent distribution afforded by the stations in the downtown district and the rapid loading afforded by three wide doors on modern rapid transit equipment proposed. Average loading of 100 passengers per car would provide better service than now rendered and would constitute a high standard of service in view of the 10-foot wide cars proposed

Plans for the construction of the Market Street subway should include provision for flexing the tracks at the future connection to the Mission route. This will insure against any interference with orderly operation, and permit complete and safe signal control of operations at the junction of these two routes. When the Market Street subway is extended beyond Van Ness Avenue, similar provisions should be made for flexing the tracks at the junction with the Sunset route. A special type of station will be required just east of Van Ness Avenue to provide for transfer movements between passengers on the future Mission Street and the Market-Twin Peaks route, as shown on Figure 11, and certain of this construction will be necessary in the initial project.

It appears that the two-track subway on Market Street will be sufficient to accommodate all traffic from the three projected rapid transit routes at the time they reach their full development and therefore the substantial additional investment required for four-track construction is not required. In this connection it might be noted that the only cities in the world having four-track subways are New York and Philadelphia. Those in New York are provided for both capacity and express train operation. Only two tracks of the four-track subway in the North Broad Street Subway in Philadelphia, constructed more than twenty years ago, have ever been utilized.

Downtown Terminal

There have been a number of varying ideas as to the charact and location of the downtown or easterly terminal of the Market Street subway. A number of reports have recommended a direct connection to the tracks of the Bay Bridge terminal so as to permit the operation of through service from points in the East Bay area to points beyond the central business district of San Francisco. Such connection - however desirable - poses an extremely difficult if not impossible physical problem.

A rather detailed study of the manner in which such connection might be effected indicates that it could be made by a six per cent grade extending continuously from a point on 2nd Street just south of Howard Street to a connection with existing Bay Bridge tracks near Rincon Street. This would, however, necessitate the closing of Harrison Street, a proposal of doubtful practicability. It would, however, be possible to keep Harrison Street open by the use of a nine per cent gradient which, in our opinion, would be inadvisable.

In the Chew plan it is proposed to carry the Bay Bridge tracks to the north on an elevated structure to a rapid transit terminal on or under Telegraph Hill, and thence by a subway connection along Montgomery Street to Market Street. This proposal has the disadvantage of indirect routing, added travel time, heavy capital cost and, finally, the construction of an elevated railroad in downtown San Francisco.

The need for adequate public transit facilities to provide suitable distribution for transbay passengers in San Francisco is recognized and in our judgment could be met by locating a subway station adjacent to the Bay Bridge terminal and providing exceptionally convenient transfer facilities at that point.

As will be discussed subsequently, the downtown terminal recommended as shown on Figure 3, provides for single track operation on 1st, Mission, Beale, Pine and Sansome Streets, with convenient connections to a division terminal to be located in the basement area of the block between Market and Mission Streets and just west of Beale Street.

In addition to the station at the Bay Bridge terminal, stations would be located at Beale and Market Streets serving the lower section of the downtown district and on Sansome Street at Bush

Street, providing convenient service to the easterly section of the financial district.

A preliminary study of the transfer station proposed at the Bay Bridge terminal is shown on Figure 4. Passengers leaving Bay Bridge trains would traverse the existing covered plaza at street level to stairways and escalators on the north side of this concourse connecting directly to the west end of the subway platform and to a passageway connecting to the subway station proper in Fremont Street.

Construction

The construction of a subway in a thorofare such as downtown Market Street can be accomplished by two methods. The track section can be constructed in tunnel with but little interference to the normal movement of vehicular and pedestrian traffic. However, auxiliary features such as ventilating shafts, subway stations at mezzanine level and the like, must be constructed by excavation from the street surface by so-called cut and cover methods. The Chicago subways were built in this manner. The experience there proved that, in the downtown areas where stations are located at frequent intervals, the cut and cover operations at the stations involved a more or less wholesale rebuilding and relocation of underground utility structures so that interference with normal movements of vehicular traffic was but little different from that which is involved in the case where the entire project is built at a high level by cut and cover methods, as in the case of the Toronto subway now under construction.

It would appear therefore that the decision as between high and low level subway may be on the basis of relative economy. Estimates of cost of the two-track section between 1st and 9th Streets have been made on each type of construction and reveal that a low level subway in this section constructed by tunneling methods would involve an additional cost of more than $7,600,000. It is recommended therefore the Market Street subway be built by cut and cover methods.

The procedures which have been developed in subway construction elsewhere consist first of stripping the pavement and material immediately below street grade. During this stage it is necessary to detour traffic in one or two blocks at a time, either on the entire

street or on one-half at a time, as may be found most expedient. The excavation is made through the pavement to a level six or eight feet below the surface to expose the existing utility pipes, ducts, and services. This work is accomplished partly with excavating equipment, but necessarily a great deal of hand work is involved. Figure 5 shows a view of Yonge Street in Toronto during this first stage of construction.

In the second stage, steel girders or trusses are attached to H-beams or steel piling driven to sound bearing below the invert of the subway structure. A heavy decking, generally consisting of twelve by twelve timbers, is then laid and normal traffic resumed. Another view of Yonge Street showing decking in place with normal traffic movements is shown in Figure 6.

All cables and pipe lines, as well as utility services, are then attached to the girders and beams supporting the decking and excavation is carried on by steam shovel down to subgrade. Excavation and construction work under the decking are shown in Figure 7.

Subsequently, the reinforced concrete structure is built entirely under the decking and when completed is backfilled, the utility structures restored, and new pavement and sidewalks laid. The entire operation, except for the interruption at the time of the original stripping operations, is carried on with but little or no inconvenience to the abutting property owners or to the motorists and pedestrians moving in or near the subway construction zone.

Local Conditions

An exceptionally detailed survey was conducted by WPA personnel in 1936 covering conditions existing at that date on Market Street - both surface and subsurface. These data were recorded on drawings on a scale of one inch equals 10 feet, and showed fully and in detail all pipes, ducts, tile, sewers, manholes, inlets, catch basins and utility services to buildings. Also recorded are fairly complete data in respect to building structures and foundations. We also have drawings furnished by the public utility companies and public agencies with underground utilities in and near Market Street, providing data on additions to or modifications of their underground plant subsequent to the WPA survey of 1936. These unusually accurate records have been of exceptional value to us in the preparation of our detailed estimates of cost of the

maintenance and restoration of underground utilities and also the cost of supporting buildings which may be affected by subway construction.

Special consideration has been given to earthquake hazards prevalent in the San Francisco area and also to the somewhat difficult soil conditions in that portion of the project near the original shore line, which includes most of the downtown single track loop and the division terminal. The reinforced concrete type structure proposed lends itself readily to the provision of the additional strength required to insure against damage due to earthquake, and the estimate covers the cost of such provisions.

Data in respect to the conditions in the lower portion of the project are given in an authoritative report made by the subsoil committee of the San Francisco section of the American Society of Civil Engineers entitled "Subsidence and the Foundation Problem in San Francisco" published December 15, 1931. This detailed report contains ample data on soil behavior and subsidence which have permitted us to incorporate in the estimates of cost special allowances for additional shoring, pumping and special structural design required to meet these conditions.

Detailed analyses of the comparative cost of reinforced concrete subway structures and the steel I-beam concrete jack arch type have been made in a number of instances during the past ten years and invariably show that the concrete structures can be built at an appreciably lower cost than the steel concrete type. In addition, the reinforced concrete structure has pleasing lines and lends itself to an excellent station finish - so important from the viewpoint of providing an attractive transportation facility.

Reinforced concrete construction also permits the design of a structure which eliminates columns on the platforms - an important feature both from the viewpoint of safety and convenience. Typical sections of the subway proposed for Market Street are shown on Figure 8. Figure 9 shows the sections to be utilized on the terminal loop where single track operation is planned.

Subway Stations

Trains in a two-track subway may be served either by side platforms or by a single center island platform. With side platform stations, it is necessary to maintain station control facilities on each side of the street, which increases the cost of attendance and reflects unfavorably on operating expenses, but permits the subway to be located at a minimum depth below the street surface. This depth is determined by the number and character of the underground utilities to be accommodated - ordinarily determined at about six or seven feet. This locates platforms about eighteen feet below the sidewalk, thus reducing the heighth of stairs, an important factor in the convenience of all passengers using the transit service.

The single center island platform, on the other hand, requires the building of a mezzanine station above the track section and increases the depth of platform and the excavation by about ten feet. The mezzanine has an element of convenience in that passengers can enter stairways on either side of the street and reach either track. On the other hand, additional depth of platform imposes additional length of stairways of ten feet which we consider more than offsets the somewhat greater flexibility of movement and simpler and less costly passenger control provided by the mezzanine station.

There is another factor in this determination which is of considerable importance. The lowering of the grade of the subway by about ten feet involves an enormous increase in the quantities of excavation, adds to the cost of supporting adjacent buildings and to the cost of the backfill. A preliminary study was made to determine the grade line required to provide mezzanines at the five stations between 8th Street and 2nd Street. From this it was determined that the additional excavating and structural work would cost approximately $3,300,000. It may be noted, however, that the mezzanines, which would be of greatest convenience to the public - those of the 2nd, 3rd and 4th Street stations - could be provided at an additional cost of approximately $1,600,000.

In view of the substantial capital outlay involved in the mezzanine station type of construction we recommend the adoption of the side platform type, with the subway located at the highest possible level. The recommended profile is shown on Figure 3.

Except for the transfer station at the Bay Bridge terminal, the station at the 3rd-Kearny intersection, and the station near Van Ness Avenue, all of the stations in the downtown section of the Market Street subway will conform generally to the typical sections shown on Figures 8 and 9. It is proposed that the Market Street subway be located south of the center line in the section between 2nd and 3rd Streets so as to provide space for the future Geary Street subway between Kearny and Montgomery Streets. This will require some deviation in the pattern of the 3rd-Kearny station where provision should be made for convenient transfer between the Market Street subway and the future Geary Street subway.

The station near Van Ness Avenue should be planned so as to provide for the operation of the trains from the Mission route. Northeast bound Mission trains would enter the Market Street subway at a junction a short distance west of the Van Ness station. It is necessary to provide in the initial construction, however, for flexing the tracks of the southwest bound Mission trains which requires the building of a two-level station at this point. Figure 11 shows a preliminary study of this station - planned to provide transfer facilities between the Mission and the Market Street routes.

West Terminal

It is necessary to lower the grade of the tracks in the Twin Peaks Tunnel for a short distance east of the west portal to provide for a suitable rail-bus transfer station either at Ulloa Street or for a subway extension in West Portal Avenue with a transfer station at St. Francis Circle. This work involves an outlay of $1,600,000, and will require closing the structure to traffic during construction operations. The tracks would be lowered to subway grade with a station located immediately west of the existing portal. If initial construction is terminated at this point, the small plaza between Ulloa Street and the tunnel portal would be utilized for a bus loop with platforms to accommodate persons transferring between bus and subway.

In view of the rather intense commercial development in West Portal Avenue, it seems desirable to include in the first construction stage the extension of the subway to St. Francis Circle. More space is available at this location for a convenient bus-rail transfer station, and passenger travel time would be reduced by providing high speed rapid transit all the way from St. Francis Circle as

compared with relatively low speed bus service in the area between St. Francis Circle and Ulloa Street. The additional cost of such extension is estimated at $4,600,000, and it is our recommendation that serious consideration be given to the inclusion of this short section of subway in the initial project.

Figure 12 shows a preliminary study of a transfer station at St. Francis Circle. Passengers would be delivered to platforms sheltered by a canopy extending entirely around the oval-shaped station; pass through turnstiles and down a short flight of stairs to board an empty subway train. Sufficient berthing space is provided for buses in this plan so that passengers leaving the subway train on the outbound trip would go directly to a bus waiting to take them to their ultimate destination. The St. Francis Circle location is strategically located with respect to development of adequate feeder bus service to the entire area - with broad and capacious thorofares leading to it from all directions.

Equipment

In addition to the subway structure, the station finish and the modern high intensity lighting system, the project necessarily will include the installation of all the fixed subway equipment necessary to provide for the operation of modern high speed rapid transit trains. This includes track; power facilities such as substations, supervisory control, circuit breakers, switchboards, feeders and distributors; as well as signal, communication, and emergency alarm systems.

The plans contemplate the installation of rails, supported on rubber pads and affixed directly to the concrete invert with a track assembly which has been developed by the Toronto Transportation Commission staff during the last few years. This type of track eliminates the older short wood tie - concrete track structure utilized in older subways, and permits a decrease in the overall heighth of subway structure of about twelve inches.

The existing trolley installation on Market Street and in the Twin Peaks Tunnel between Van Ness Avenue and the West Portal warrant the extension of this trolley system throughout the project and this is contemplated. It will be necessary to rehabilitate virtually all of the power facilities through the Twin Peaks Tunnel and such work is included in the estimates of cost.

A modern central train control signal system will be established with control facilities located in the Beale Street division terminal. Control of train movements at all terminals and junctions in the entire system, including the southwest terminal (either at Ulloa Street or St. Francis Circle), will be maintained at this control center.

The car equipment recommended for operation in San Francisco will conform generally to the plans and specifications developed by a special committee of the American Transit Association. This committee is composed of representatives of transit companies in Boston, Chicago, Cleveland, San Francisco and Toronto who have been engaged in a cooperative study for several years to develop a practicable light weight, high speed car for train operation. There has been agreement on virtually all features of this car so that future purchasers will gain the benefit of standardization which has been accomplished by the A. T. A. committee with the cooperation of the manufacturers.

Generally speaking, the cars will be similar to the modern street cars known as the PCC cars. The design is modified, however, to provide for the multiple unit control essential to train operation, and also to provide three wide doors on each side of the car for convenient and expeditious movement of passengers between cars and platforms. A car width of ten feet is recommended to provide greater capacity and added convenience. Cars would be equipped with pantographs for operation with trolleys as mentioned above. The semi-permanent coupling of cars in units of two, with a cab at each end of the two-car unit, is part of the basic American Transit Association committee design. This provides for double-end operation made necessary in San Francisco by the stub terminal at the southwest terminal. Such arrangement, however, will require the operation of trains two, four or six cars in length.

Division Terminal

Facilities will be required for cleaning, for making running repairs, and for storage of the cars required for operation of the subway subsequent to the completion of the initial stage. An exhaustive survey was made of sites which might be available for this purpose. The fact was developed that no suitable site was available at or near the west portal of the Twin Peaks Tunnel or the Sunset Tunnel. Numerous sites were considered in the central business district both adjacent to the downtown terminal loop and adjacent to Market Street. Consideration was given to the present

use of properties which might be taken for this purpose and to the effect of such development on commercial activities in its vicinity. After a study of these factors and the preparation of comparative estimates of cost of land and buildings, a site was selected covering the entire block between Mission and Market Streets and north of Beale Street as shown on Figure 13. Adequate facilities for running repairs, cleaning and storage are located there, as shown. Based on cars approximately fifty feet long, there is space for 79 cars which is ample for the operation of Market Street and the Sunset routes. It is not contemplated that heavy repairs would be made at this terminal. Provisions are incorporated for a lift from the basement level to the street level to provide for the transfer of car bodies from the division terminal to the central repair shop to be built shortly at Geneva Avenue. Cars, which require major overhauling at intervals from three to five years, would be transported over the streets during the early morning hours on a specially designed trailer.

This location of the division terminal provides for efficient and economical operation in that car equipment used during the morning rush period would be stored during the base hours and added to the service to provide for longer train operation during the afternoon rush period. This eliminates the dead mileage which would be involved if the division terminal were located at or near the outer ends of the routes. The preliminary layout includes provision for a tail track to facilitate such operation.

Except for space required for the large elevator, all of the division terminal facilities would be located underground. This would permit resale of the air rights, and it is estimated that a substantial portion of the investment in land may be recaptured by such sale. The accumulation of this large area in the downtown district might prove to be of extraordinary value for a large warehousing project, or perhaps for the development of parking facilities - badly needed in this area. The estimate, however, includes the cost of all land and buildings in the entire block, with no allowance for sale of air rights.

Estimate of Cost

The cost of the initial construction of the Market Street subway extending from the downtown terminal to the southwest terminal at St. Francis Circle is set forth below. The estimate includes all of

the cost of construction of the subway, station finish, and lighting of the highest and most modern type, the installation of the fixed subway equipment, and the purchase of modern rapid transit cars sufficient for the initial operation. We have no legal advice as to the liability of the several parties at interest to pay the costs involved in the maintenance and restoration of existing underground utility structures, so that the estimate includes an allowance for this rather heavy item of cost. Neither do we have information as to the responsibility for the maintenance of abutting buildings along the subway routes so that the estimates have been made likewise to include the cost of such work.

ESTIMATE OF COST - MARKET STREET SUBWAY

Subway construction from downtown terminal loop to incline just west of Van Ness Avenue - complete except for subway equipment and also maintenance and restoration of underground utilities	$18,400,000	
Maintenance and restoration of underground utilities	3,500,000	
Total Cost of Basic Construction		$21,900,000
Rapid Transit Division Terminal:		
Land and buildings	$ 3,450,000*	
Structure and fixed equipment	3,350,000	
Total Cost of Division Terminal		6,800,000*
Restoration of westerly portion of Twin Peaks Tunnel and two-track subway extension to a terminal at St. Francis Circle	$ 5,600,000	
Maintenance and restoration of underground utilities	200,000	
Total Cost of Westerly Section		5,800,000
Fixed subway equipment including track, signal, D.C. power and distribution, supervisory control, A.C. distribution, emergency alarm, communication, ventilating and station equipment		5,800,000
60 Rapid Transit Cars		2,700,000
Total Estimated Cost - Initial Program		$43,000,000

*-No allowance for resale of air rights above street grade.

SUNSET ROUTE

There have been differences of opinion in previous transportation reports as to the best method of utilizing the existing 4,000-foot Sunset Tunnel, and as to how best to serve the important Sunset district to the south of Golden Gate Park and west of Mt. Sutro. Certain proposals have included the extension of the Sunset Tunnel to a connection with the Market Street subway with an extension by subway or open cut to the west of the existing tunnel portal so as to provide rapid transit train service to the Sunset district. Other reports have suggested trolley bus service which would provide direct service between the local areas served in the Sunset district through the Sunset Tunnel and to a downtown delivery along Market Street.

There is a difference of opinion as to the practicability of operation of trolley buses through the Sunset Tunnel, and also as to the relative convenience of the service. With the trolley bus scheme, a through service could be provided operating with limited stops after leaving the local feeder area so as to provide for an exceptionally high overall schedule speed between 9th Avenue on the west and Van Ness Avenue on the east. The convenience of such service without transfer is not subject to question.

On the other hand, there are certain elements of flexibility in a scheme which provides for the operation of trains to a terminal located in the vicinity of Stanyan Street and eventually as far west as 19th Avenue, with feeders providing intimate coverage of all of the residential areas to be served. Provisions could be made for convenient transfer of passengers but it is inevitable that there is some loss of time involved in such transfer. The question involved is one of transportation policy rather than engineering. We have prepared preliminary studies and estimates of cost on three alternate plans.

Train Operation - Cole Street Terminal

This plan involves the construction of a bus-rail transfer station on the presently city-owned property adjacent to the west portal of the Sunset Tunnel, the lowering of the tracks at that point, and the construction of a bus roadway above same with a new connecting roadway to Cole Street. In addition, it would be necessary to rehabilitate the power facilities and the tracks in the Sunset Tunnel.

Under this plan trains would operate through the Market Street subway to the Van Ness Avenue incline and along Market Street and Duboce Avenue to and through the Sunset Tunnel to the above described bus-rail transfer station near Cole Street. It should be noted that the Sunset Tunnel is so constructed as to make it physically impossible to construct a subway connection from the east portal to the Market Street subway without lowering the tracks in more than one-half of the existing tunnel structure. The cost of the project as above outlined including the acquisition of rapid transit cars required for this operation is estimated as follows:

Rehabilitation of track and electrical equipment in Sunset Tunnel	$ 800,000
Construction of terminal station, including bus platforms and roadways and also fixed equipment	420,000
Land and damages	100,000
24 Rapid transit cars	1,080,000
Total	$2,400,000

Train Operation - Stanyan Street Terminal

This plan is similar to the Cole Street development described above except that the rapid transit tracks would be extended in open cut passing under Cole Street to a more commodious transfer station located at the corner of Stanyan Street and Frederick Street. This terminal would involve the acquisition of a substantial amount of privately-owned land and buildings but would provide adequately for all of the feeder bus routes which would be required to serve the important Sunset district. The cost of this project including right-of-way, rehabilitation of power facilities and track in the Sunset Tunnel is estimated as follows:

Rehabilitation of track and electrical equipment in Sunset Tunnel	$ 800,000
Construction of terminal station, including bus platforms and roadways and also fixed equipment	1,070,000
Land and damages	650,000
24 Rapid transit cars	1,080,000
Total	$3,600,000

Trolley Bus Operation

To provide for trolley bus operation as suggested, it would be necessary to remove the existing tracks, construct a suitable pavement, rehabilitate the existing power system and add necessary overhead trolleys for trolley bus operation and, in addition, to provide for suitable lighting throughout the tunnel with intensities ranging upwards from one-foot candle at the pavement level. This work is estimated to cost approximately $500,000. No estimate has been made of the overhead electrical work beyond the portals of the Sunset Tunnel nor of the cost of trolley buses required for this operation.

It should be noted in the consideration of these projects that electric overhead and power supply has already been provided on the lower portion of Market Street and, further, that with the completion of the Market Street subway all street cars now operated over the surface of the street will disappear. Another factor which might be considered is that the installation of modern synchronized traffic control signals will accelerate the speed of all traffic, including trolley buses, in the downtown section of Market Street.

CONCLUSION

The recommended initial rapid transit development, co-ordinated with the completely modernized surface system of trolley bus and gas bus routes, provides for greatly improved transit service throughout San Francisco. In addition to the measurable improvement in rider convenience resulting from substantial reductions in travel time, there will be numerous indirect and general benefits.

The reduced travel times plus the opportunity to ride in commodious modern cars will invite and should stimulate new patronage. The subway will be planned with a view to providing the utmost in convenience, safety and comfort to the riders. Stations will be given an attractive and inviting finish by the liberal use of stainless steel, structural glass and tile. They will be well ventilated at all times and provided with acoustical treatment. Special emphasis will be given to modern, high intensity illumination throughout.

Safety will be incorporated in the design through modern central train control signals, supervisory power control, and emergency alarm and communications systems The structures will be fireproof and with extra strength added to provide safety for passengers in any emergency - even under severe earthquake conditions.

Traffic flow, especially in Market Street, will be improved by the elimination of trolley car operations throughout San Francisco. The improved public transit will tend to reduce the automobile traffic, especially during the morning and afternoon rush periods - a further benefit to all of San Francisco.

The transfer of passengers from low speed - high cost transit vehicles operating on the street surface (buses or trolley buses) to high speed - low cost rapid transit trains will have a beneficial effect on the operating expenses of the Municipal Railway - which in turn will be passed on to transit riders in the determination of transit fares from time to time.

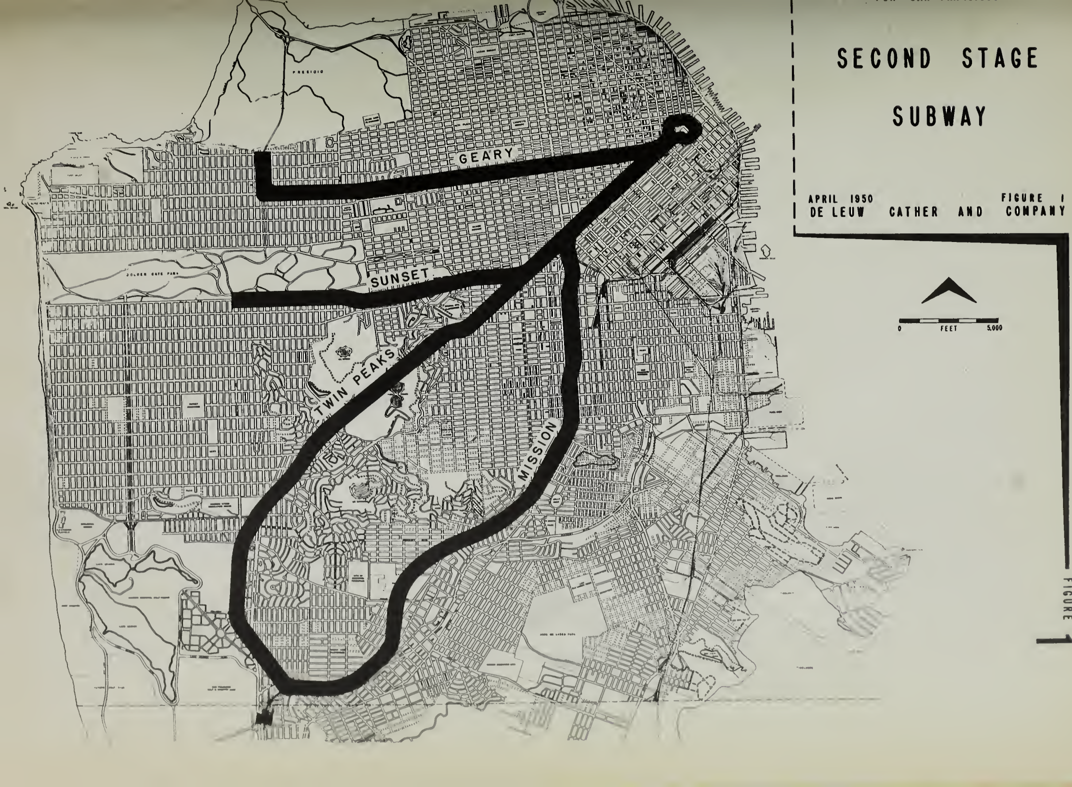
Finally, the orderly development of public transit as proposed will have a beneficial effect in stabilizing and in most cases, stimulating business and property values in the downtown as well as in the outlying commercial centers of San Francisco.

Respectfully submitted,

DE LEUW, CATHER & COMPANY

Charles E. DeLeuw

FIGURES


PRESIDIO
GOLDEN GATE PARK
GEARY
SUNSET
TWIN PEAKS
MISSION
0
FEET
5,000

SECOND STAGE
SUBWAY

APRIL 1950
DE LEUW CATHER AND COMPANY

FIGURE 1

FIGURE 1

SUBWAY AND RAPID TRANSIT SYSTEM
FOR SAN FRANCISCO

FIRST STAGE

SUBWAY

APRIL 1950 FIGURE 2
DE LEUW CATHER AND COMPANY

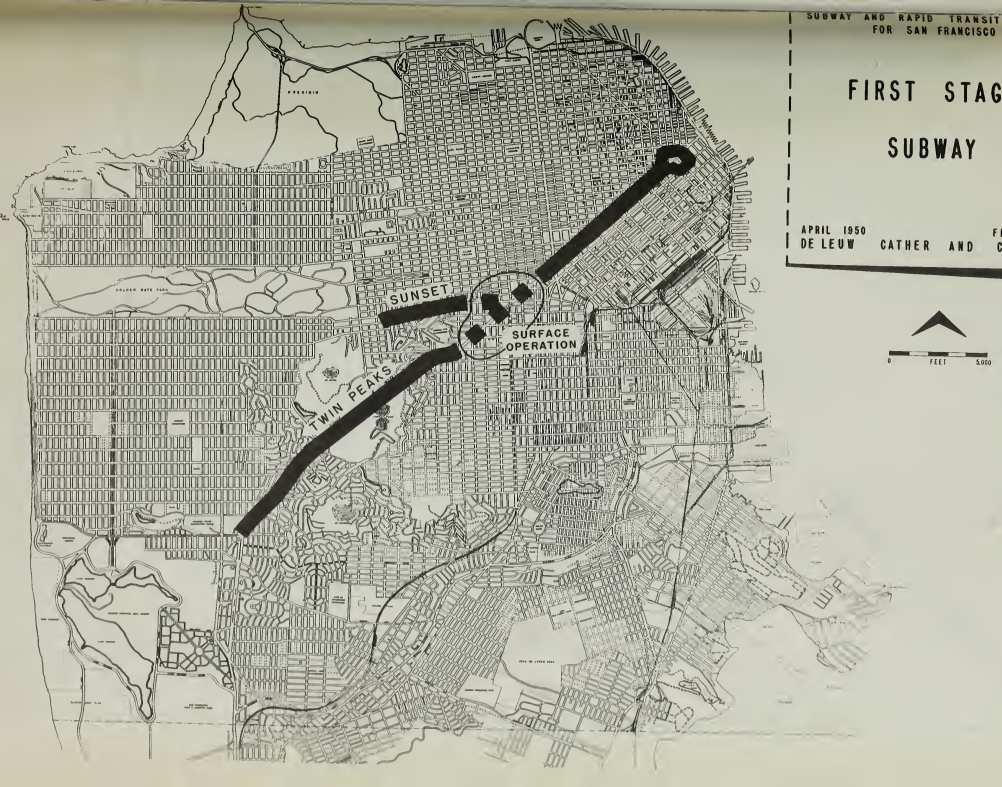
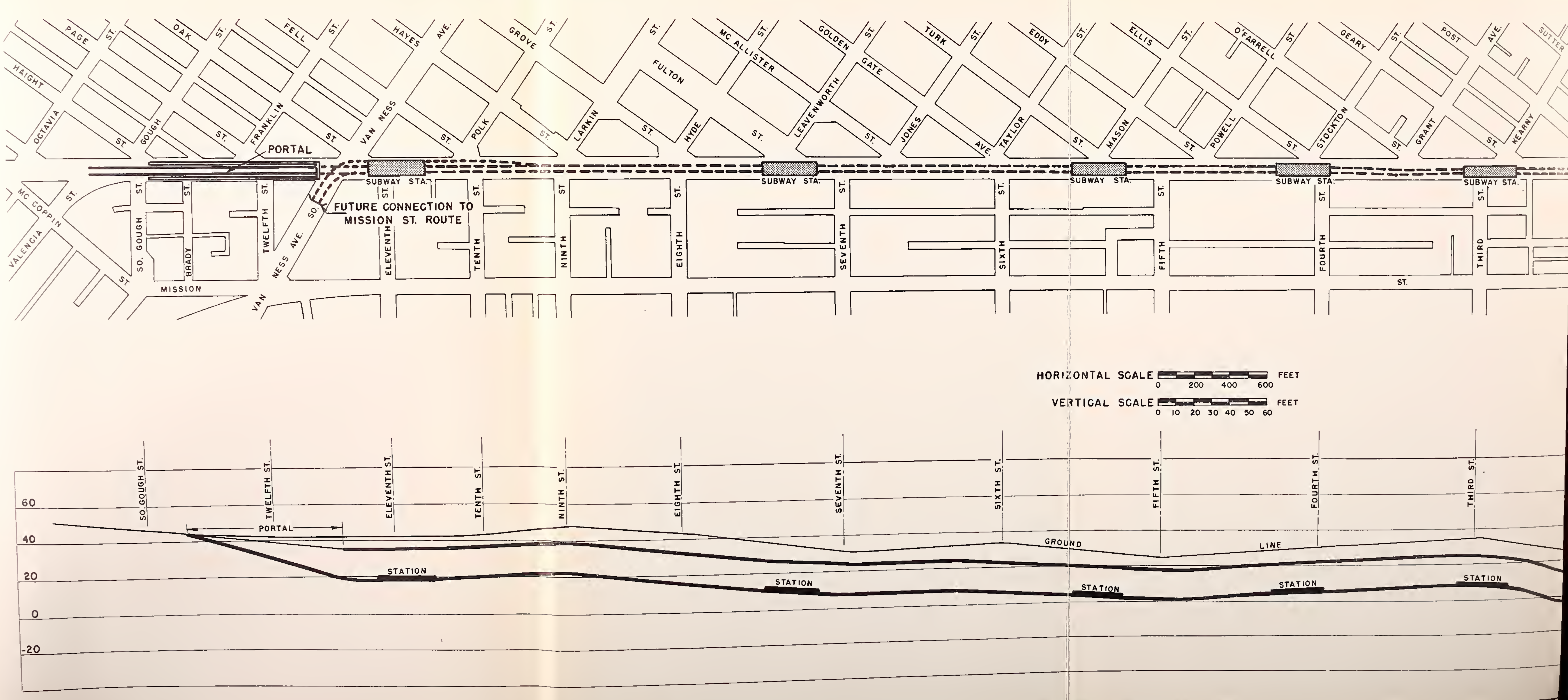
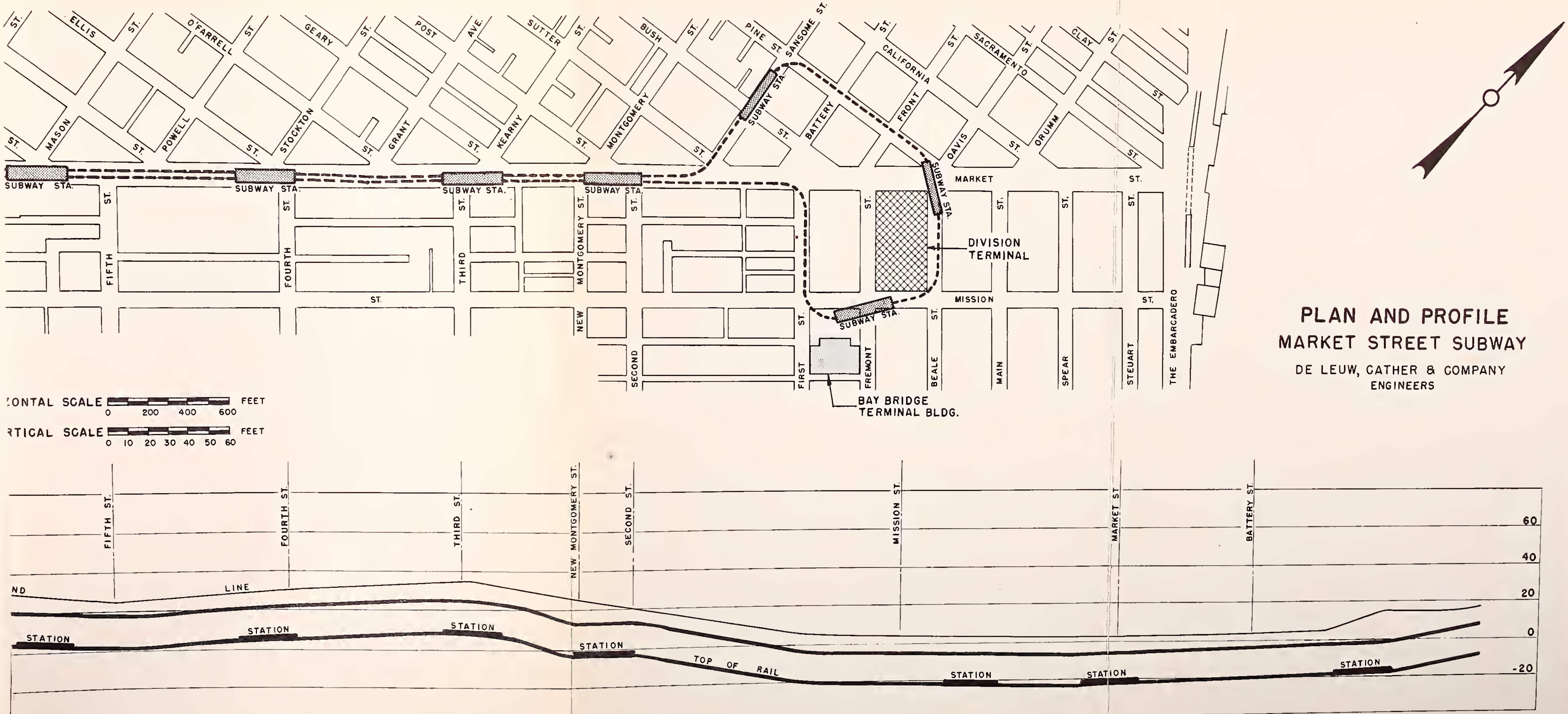

PRESIDIO
GOLDEN GATE PARK
SUNSET
SURFACE OPERATION
TWIN PEAKS
0
FEET
5,000

FIGURE 2

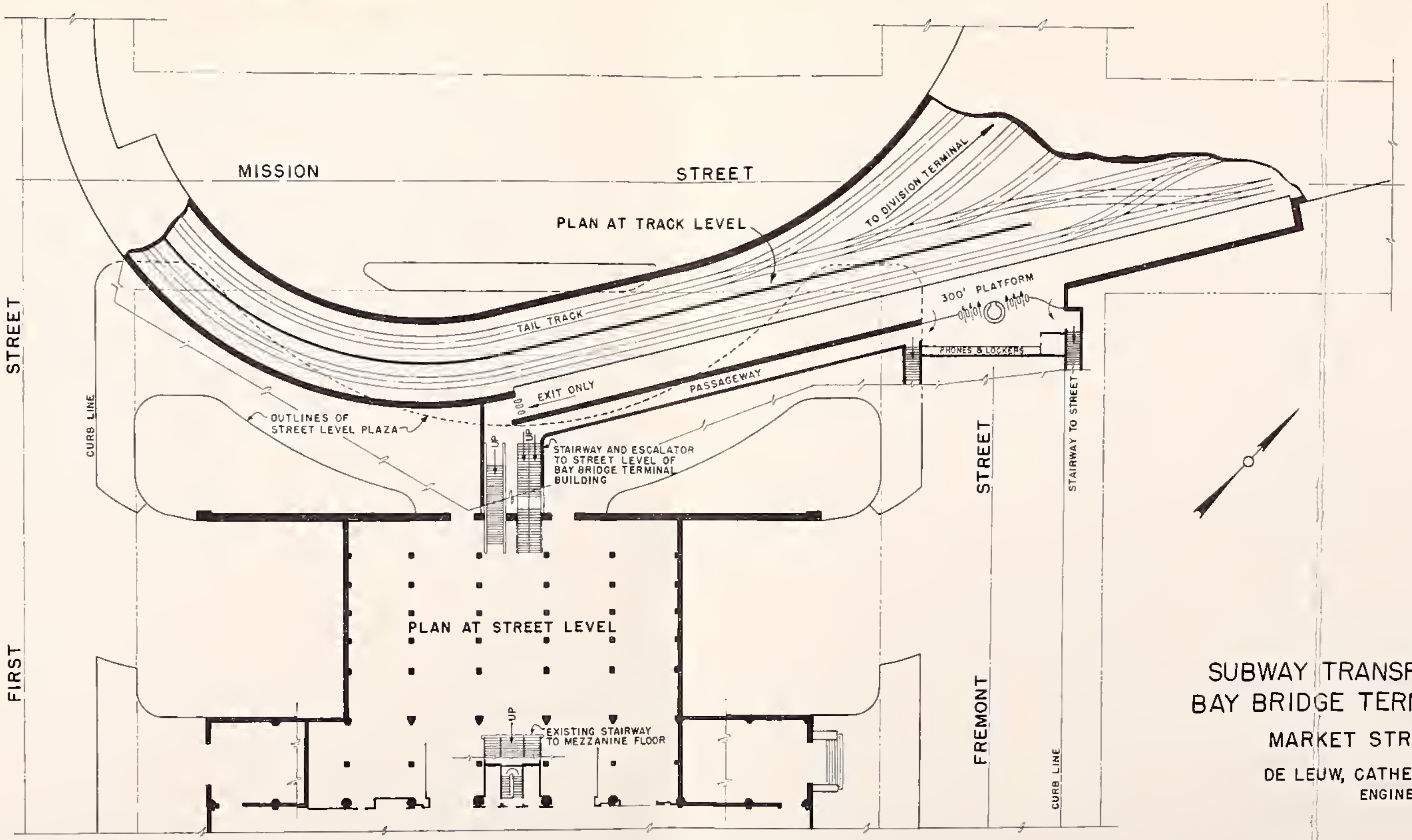

PORTAL
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
FUTURE CONNECTION TO
MISSION ST. ROUTE
HAIGHT
PAGE ST.
OAK ST.
FELL ST.
HAYES AVE.
GROVE ST.
FULTON ST.
MC ALLISTER ST.
GOLDEN GATE AVE.
TURK ST.
EDDY ST.
ELLIS ST.
O'FARRELL ST.
GEARY ST.
POST AVE.
SUTTER
OCTAVIA ST.
GOUGH ST.
FRANKLIN ST.
VAN NESS AVE.
POLK ST.
LARKIN ST.
HYDE ST.
LEAVENWORTH ST.
JONES ST.
TAYLOR ST.
MASON ST.
POWELL ST.
STOCKTON ST.
GRANT ST.
KEARNY
MC COPPIN ST.
VALENCIA ST.
SO. GOUGH ST.
BRADY ST.
TWELFTH ST.
SO. VAN NESS AVE.
ELEVENTH ST.
TENTH ST.
NINTH ST.
EIGHTH ST.
SEVENTH ST.
SIXTH ST.
FIFTH ST.
FOURTH ST.
THIRD ST.
MISSION ST.
HORIZONTAL SCALE FEET
0 200 400 600
VERTICAL SCALE FEET
0 10 20 30 40 50 60
60
40
20
0
-20
PORTAL
STATION
STATION
STATION
STATION
STATION
GROUND LINE


ST.
ELLIS
ST.
O'FARRELL
ST.
GEARY
ST.
POST
AVE.
SUTTER
ST.
BUSH
ST.
PINE
ST.
SANSOME
ST.
ST.
CALIFORNIA
ST.
SACRAMENTO
ST.
CLAY
ST.
ST.
MASON
ST.
POWELL
ST.
STOCKTON
ST.
GRANT
ST.
KEARNY
ST.
MONTGOMERY
ST.
ST.
BATTERY
FRONT
DAVIS
ST.
DRUMM
ST.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
SUBWAY STA.
MARKET
ST.
DIVISION
TERMINAL
MISSION
ST.
ST.
FIFTH
ST.
FOURTH
ST.
THIRD
ST.
NEW MONTGOMERY ST.
SECOND
ST.
FIRST
FREMONT
ST.
BEALE
ST.
MAIN
ST.
SPEAR
ST.
STEUART
ST.
THE EMBARCADERO
BAY BRIDGE
TERMINAL BLDG.
ZONTAL SCALE
0
200
400
600
FEET
RTICAL SCALE
0
10
20
30
40
50
60
FEET
FIFTH ST.
FOURTH ST.
THIRD ST.
NEW MONTGOMERY ST.
SECOND ST.
MISSION ST.
MARKET ST.
BATTERY ST.
ND
LINE
STATION
STATION
STATION
STATION
TOP OF RAIL
STATION
STATION
STATION
60
40
20
0
-20

PLAN AND PROFILE
MARKET STREET SUBWAY

DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 3


MISSION
STREET
PLAN AT TRACK LEVEL
TO DIVISION TERMINAL
TAIL TRACK
300' PLATFORM
PHONES & LOCKERS
EXIT ONLY
PASSAGEWAY
OUTLINES OF STREET LEVEL PLAZA
STAIRWAY AND ESCALATOR TO STREET LEVEL OF BAY BRIDGE TERMINAL BUILDING
UP
UP
CURB LINE
FIRST
STREET
PLAN AT STREET LEVEL
UP
EXISTING STAIRWAY TO MEZZANINE FLOOR
FREMONT
STREET
STAIRWAY TO STREET
CURB LINE

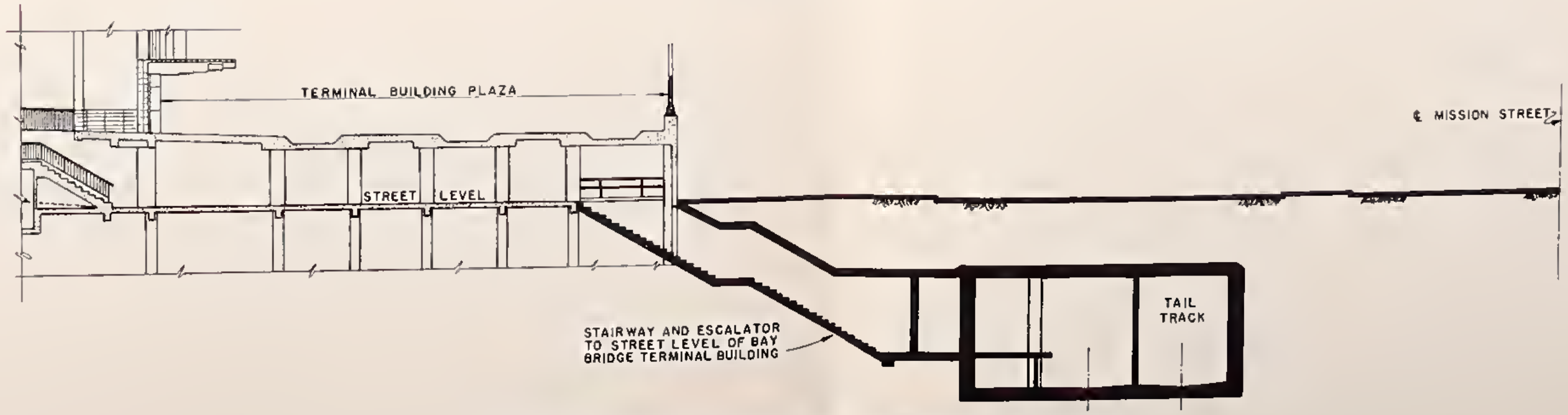
PLAN AT BAY BRIDGE TERMINAL BUILDING

0 10 20 30
SCALE IN FEET

SUBWAY TRANSFER STATION AT BAY BRIDGE TERMINAL BUILDING

MARKET STREET SUBWAY

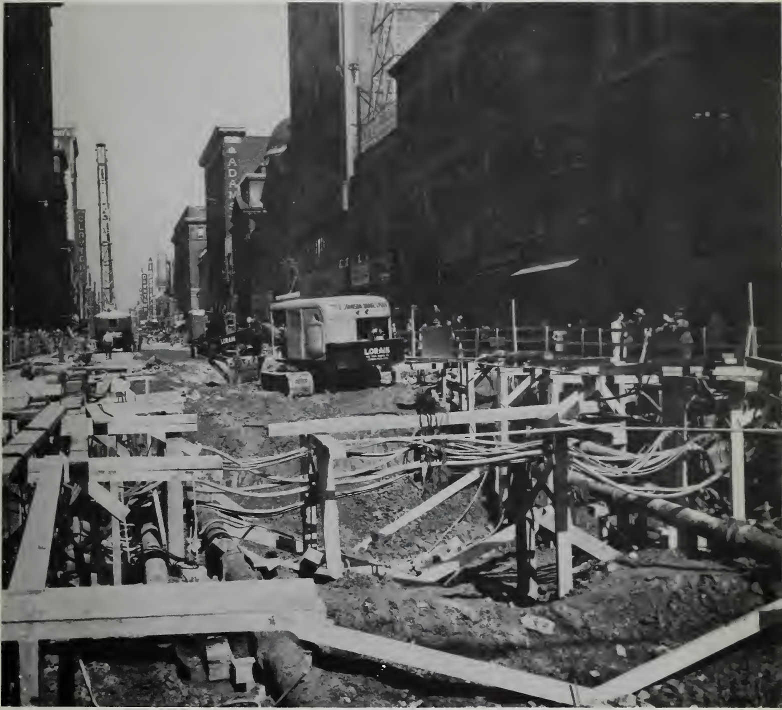
DE LEUW, CATHER & COMPANY
ENGINEERS


TERMINAL BUILDING PLAZA
℄ MISSION STREET
STREET LEVEL
TAIL TRACK
STAIRWAY AND ESCALATOR TO STREET LEVEL OF BAY BRIDGE TERMINAL BUILDING

SECTION THRU BAY BRIDGE TERMINAL BUILDING

0 5 10 15
SCALE IN FEET

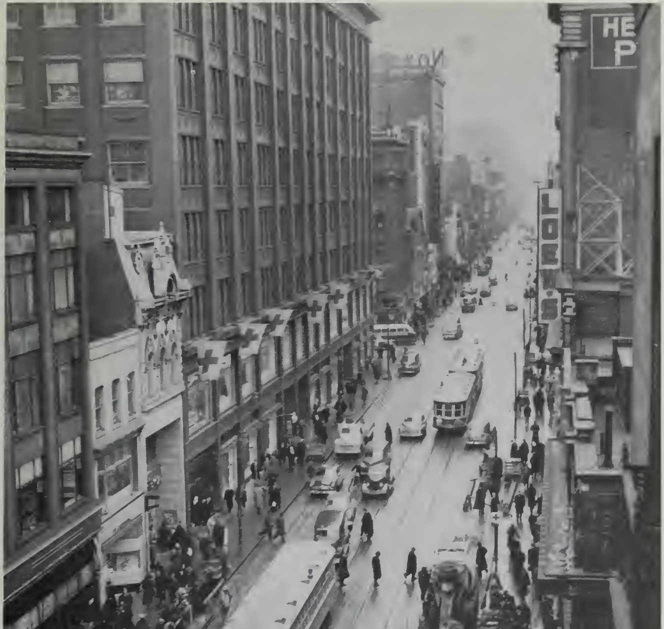
FIGURE 4


ADAMS
LORAIN

SUBWAY CONSTRUCTION—TORONTO

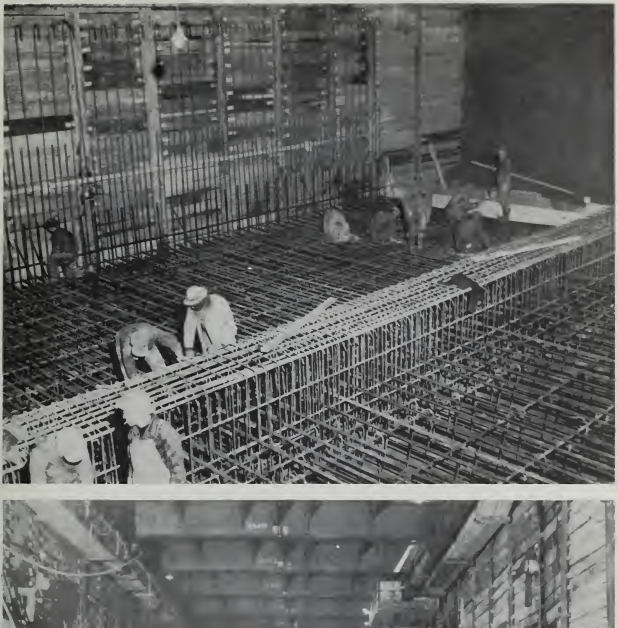
INITIAL STRIPPING OPERATION

FIGURE 5



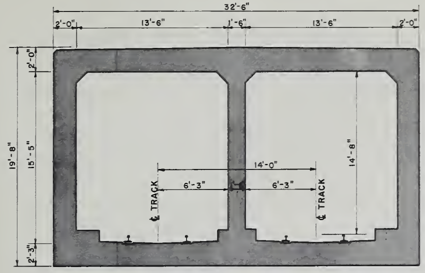
SUBWAY CONSTRUCTION — TORONTO
DECKING IN PLACE

FIGURE 6

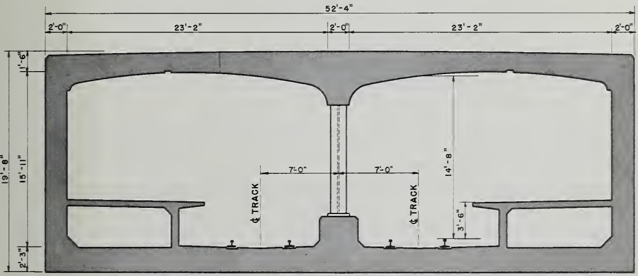


SUBWAY CONSTRUCTION — TORONTO
UNDER DECKING

FIGURE 7


32'-6"
2'-0"
13'-6"
1'-6"
13'-6"
2'-0"
2'-0"
19'-8"
15'-5"
2'-3"
14'-8"
14'-0"
6'-3"
6'-3"
℄ TRACK
℄ TRACK

DOUBLE TRACK BETWEEN STATIONS


52'-4"
2'-0"
23'-2"
2'-0"
23'-2"
2'-0"
1'-6"
19'-8"
15'-11"
2'-3"
7'-0"
7'-0"
℄ TRACK
℄ TRACK
14'-8"
3'-6"

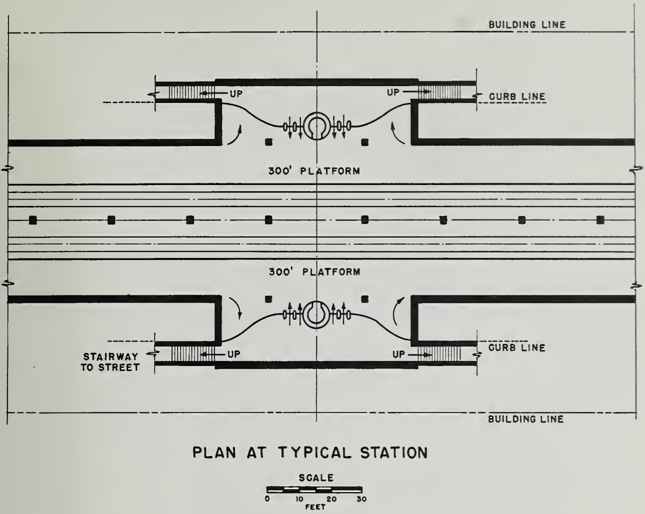
DOUBLE TRACK AT STATIONS

TYPICAL SECTIONS—TWO-TRACK SUBWAY

MARKET STREET SUBWAY

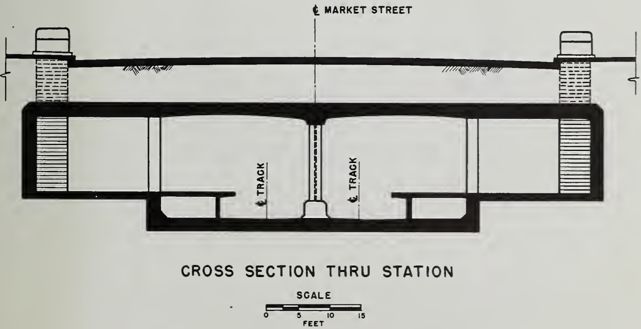
DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 8


BUILDING LINE
UP
UP
CURB LINE
300' PLATFORM
300' PLATFORM
STAIRWAY TO STREET
UP
UP
CURB LINE
BUILDING LINE

PLAN AT TYPICAL STATION

SCALE
0 10 20 30
FEET


℄ MARKET STREET
℄ TRACK
℄ TRACK

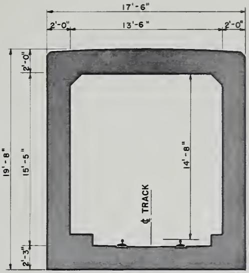
CROSS SECTION THRU STATION

SCALE
0 5 10 15
FEET

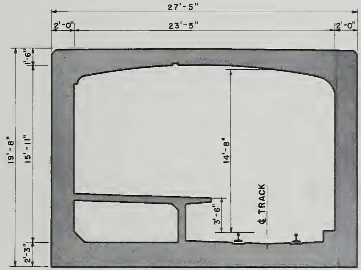
TYPICAL SUBWAY STATION
MARKET STREET SUBWAY

DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 9


17'-6"
2'-0"
13'-6"
2'-0"
2'-0"
19'-8"
15'-5"
14'-8"
℄ TRACK
2'-3"

SINGLE TRACK BETWEEN STATIONS

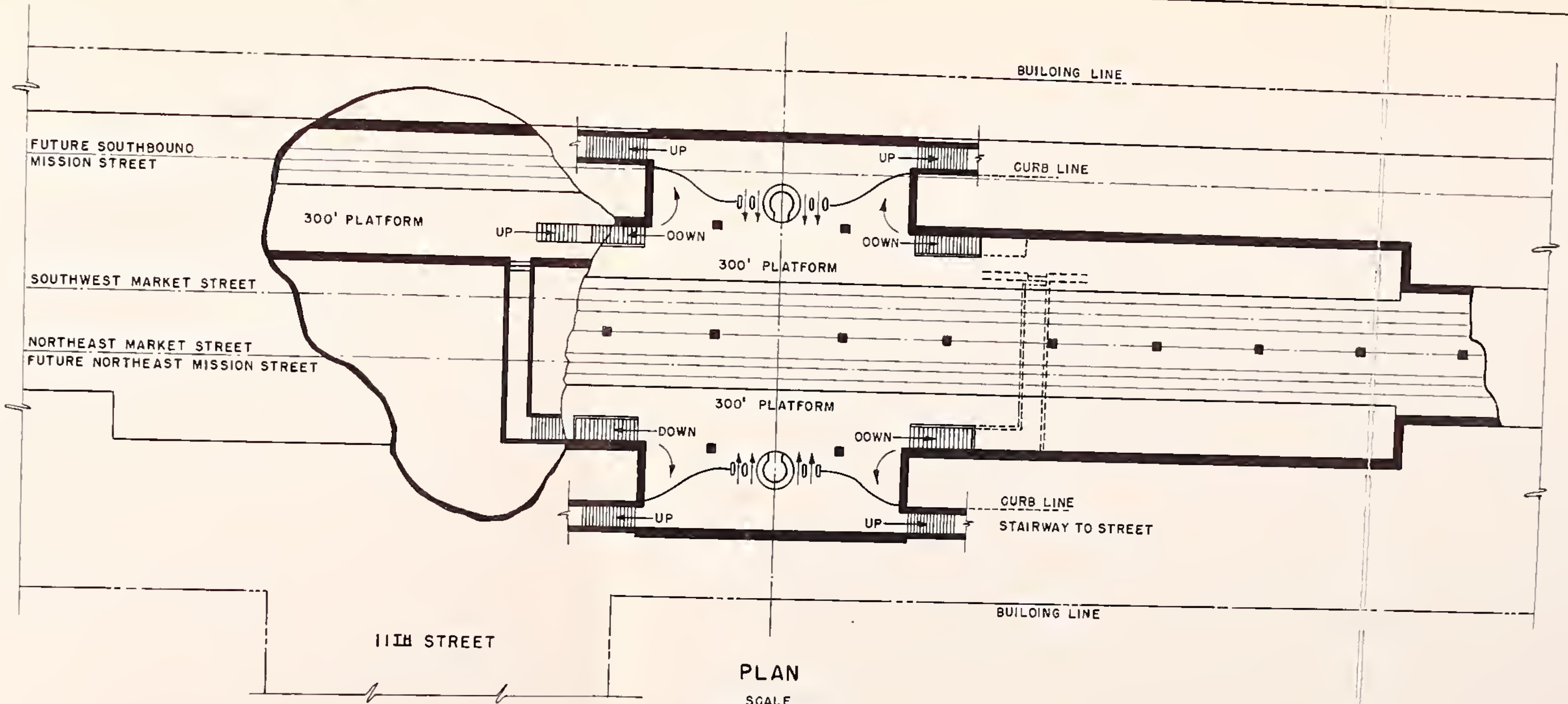

27'-5"
2'-0"
23'-5"
2'-0"
1'-6"
19'-8"
15'-11"
14'-8"
3'-6"
℄ TRACK
2'-3"

SINGLE TRACK AT STATIONS

TYPICAL SECTIONS—ONE-TRACK SUBWAY
MARKET STREET SUBWAY

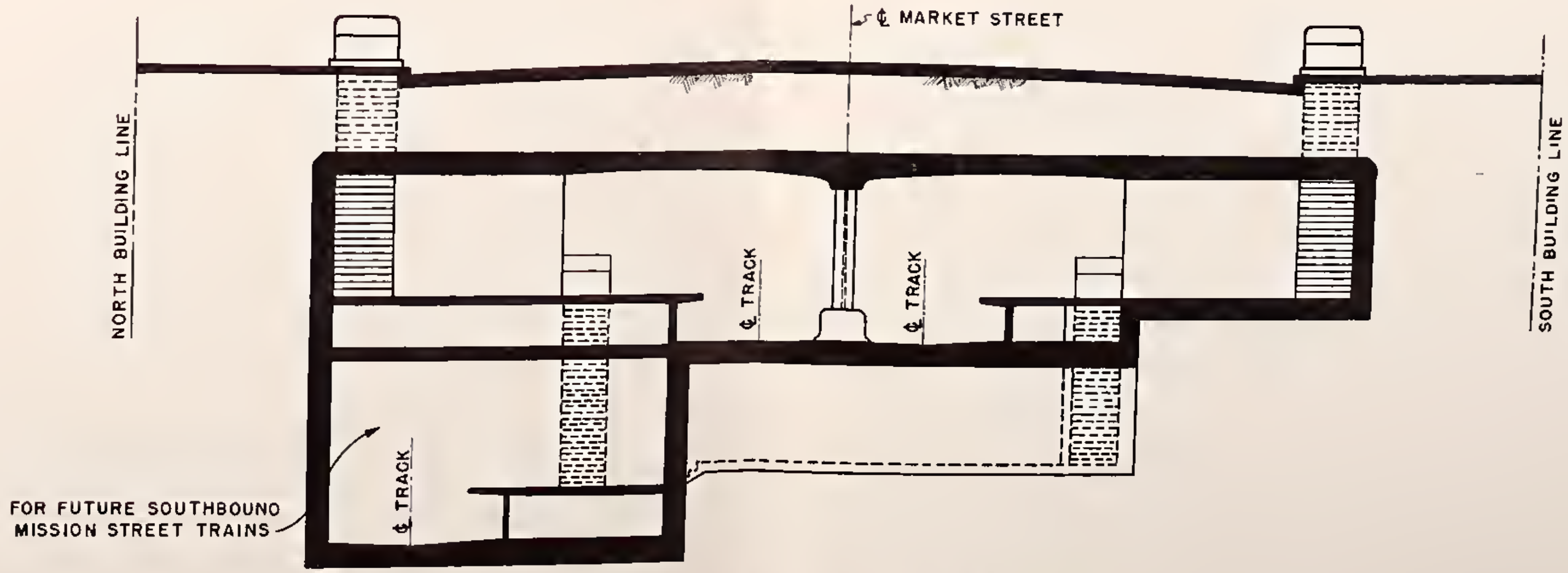
DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 10


BUILDING LINE
FUTURE SOUTHBOUND MISSION STREET
CURB LINE
UP
DOWN
300' PLATFORM
SOUTHWEST MARKET STREET
NORTHEAST MARKET STREET
FUTURE NORTHEAST MISSION STREET
STAIRWAY TO STREET
11TH STREET

PLAN

SCALE
0 10 20 30
FEET


℄ MARKET STREET
NORTH BUILDING LINE
SOUTH BUILDING LINE
℄ TRACK
℄ TRACK
℄ TRACK
FOR FUTURE SOUTHBOUND MISSION STREET TRAINS

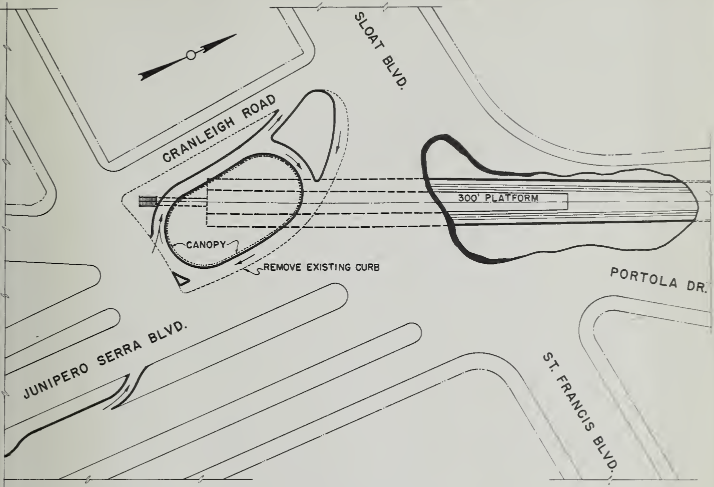
CROSS SECTION THRU STATION

SCALE
0 5 10 15
FEET

PRELIMINARY PLAN
TRANSFER STATION NEAR VAN NESS AVENUE

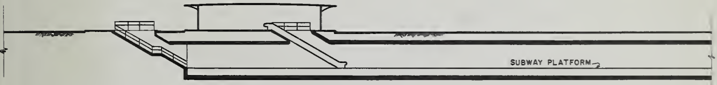
DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 11


SLOAT BLVD.
CRANLEIGH ROAD
300' PLATFORM
CANOPY
REMOVE EXISTING CURB
PORTOLA DR.
JUNIPERO SERRA BLVD.
ST. FRANCIS BLVD.

PLAN

0 20 40 60 80
SCALE IN FEET

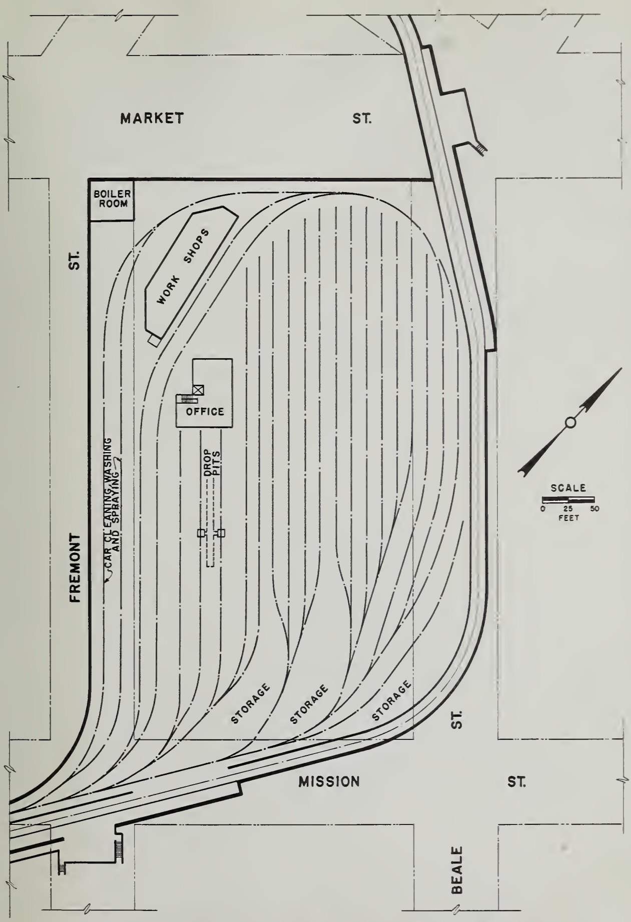

SUBWAY PLATFORM

SECTION ALONG CENTER LINE

0 10 20 30
SCALE IN FEET

PRELIMINARY STUDY
BUS—RAIL TRANSFER STATION AT
ST. FRANCIS CIRCLE TERMINAL
MARKET STREET SUBWAY
DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 12


MARKET
ST.
BOILER ROOM
WORK SHOPS
OFFICE
FREMONT
ST.
CAR CLEANING WASHING AND SPRAYING
DROP PITS
STORAGE
STORAGE
STORAGE
ST.
BEALE
MISSION
ST.
SCALE
0
25
50
FEET

PRELIMINARY PLAN — DIVISION TERMINAL
MARKET STREET SUBWAY
DE LEUW, CATHER & COMPANY
ENGINEERS

FIGURE 13